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ROYAL ALBUM

OF

ARTS AND INDUSTRIES

OF

GREAT BRITAIN.

QUEEN VICTORIA
1837 - 1887

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ROYAL ALBUM

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ARTS AND INDUSTRIES

OF

GREAT BRITAIN.

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THIS VOLUME

IS

HER MOST GRACIOUS MAJESTY

QUEEN VICTORIA,

ON THE OCCASION

OF THE

FIFTIETH ANNIVERSARY OF HER REIGN,

BY

HER MOST OBEDIENT, HUMBLE SERVANTS,

THE PUBLISHERS.

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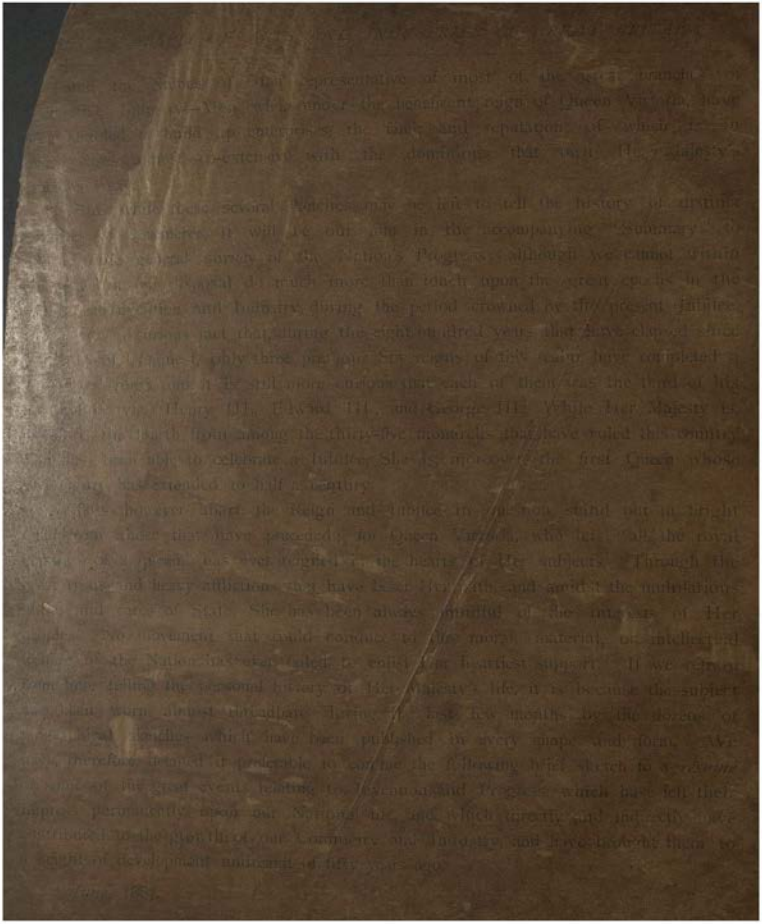

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HER MAJESTY'S REIGN,

1837-1887.

Her Majesty's Reign.

National and Industrial Progress, 1837–1887.

MIGHTY COMMERCE, hail!
Parent of wealth! in vain coy Nature hoards
Her gold and diamonds; Toil, thy firm compeer,
And Industry of unremitting nerve,
Scale the cleft mountain, the loud torrent brave,
To pour them plenteous on the laughing world.
By thee, white Albion, once a barbarous clime,
Grew famed for arms, for wisdom, and for laws;
By thee she holds the balance of the world,
Acknowledged now sole empress of the main.
Coy though thou art, and mutable of love,
Here may'st thou ever fix thy wandering steps.

OMMERCIAL, Social, and Political life has during the Victorian Half-century undergone so marked a change, as has never before been witnessed in the whole history of this or any other nation. The last fifty years have been characterised more than any preceding period by the development of industry, the growth of commerce, the improvement of manufacturing processes, the perfection of machinery, the introduction of new inventions, and the application of science to the useful arts. These various agencies have all made themselves felt in promoting the physical and moral well-being of the nation. Everywhere there has been unparalleled progress; the tide of industry and art may be said to have changed the whole material aspect of this country, and what fifty years ago was regarded as the wildest dream of imagination, has in our own day come to be looked upon as a matter of everyday life. In much of what ministers to our social comforts and conveniences, we seem separated by a century or two, rather than by the space of a single reign, from Englishmen of the days of William IV. As a nation, we appear to have passed as it were during the intervening period from infancy to maturity. Our arts and industries have since then advanced by leaps and bounds, and the date of Her Majesty's accession may indeed be regarded as the starting-point of scientific discoveries and inventions which have proved of immeasurable benefit to mankind. The present age stands out in bold relief from its predecessors by the miracles which have been wrought in the subjugation of the material world to the uses of the human race. A moment's reflection will show

that the gifts of Science to Industry in our own time have been almost innumerable. The invention of the electric telegraph, the application of steam to transatlantic navigation, the electric light, the art of photography, the telephone and microphone—these are only a few of the most powerful agents of civilisation, which have helped to annihilate time and space, and the birth of all of which, be it remembered, has been witnessed by the present generation. Equally great have been the achievements in other directions; and every branch of human knowledge has been influenced by the scientific investigations of the last five decades. The advances made in metallurgy, electricity, chemistry, and all the other sciences, have reacted upon and benefited trade and commerce, in all their manifold ramifications. The positive influence of science has asserted itself on every hand in the application of mechanics to the material arts, in the improved shape of the tools and machines employed in our workshops, and in the simplification of manufacturing processes, which have in turn resulted in economy of labour and material.

Co-operating with the men of science, our leading manufacturers, too, have made their impress upon the nineteenth century, and the result of their labour can be seen in the improved character of all our surroundings, of our food and clothing, of our luxuries and necessaries. Progressive civilisation and mechanical power have everywhere asserted their benign influence. Our great Leaders of industry have been conspicuous for their readiness to adapt and adopt every improvement which could conduce to the production of better articles of merchandise. The names and the history of some of those Firms who have taken a principal part in effecting the development of British industry which is brought so prominently before us in this the Jubilee Year, will be found recorded in a subsequent section of this ALBUM OF ARTS AND INDUSTRIES. It is to their efforts, and to the efforts of other Firms of which they are typical, that we are indebted for that supremacy among manufacturing nations which we enjoy. A reference to that portion of the present work will show that individual manufacturers and merchants have accomplished no less important revolutions in their several branches of Commerce than are those which characterise our national existence as a whole. A glance through this Peerage of Commerce will demonstrate that (to slightly vary a line of Wordsworth's) "Great men are still amongst us" in well-nigh every branch of industry,—men whose names and productions are familiar as household words in this and other lands,—men who conjointly by their sterling honour, their keen insight, their ripe judgment, their untiring application, their originality of invention, and persevering patience in working out details, their spirit of enterprise, and their lavish investment of capital, have been instrumental in building up our manufacturing greatness, and whose world-wide commercial undertakings have helped to shed additional lustre upon a reign singularly rich in its achievements in the Arts of Peace.

Foremost from among the great and beneficent agencies which were called into existence about the beginning of the period under notice stand out Railways, they being, strictly speaking, creations of the present century. In 1801 the first Act of Parliament was passed for the construction of such a public line of inter-communication. It was granted in favour of the Surrey Iron Railway Company, which body had been incorporated "for making and maintaining a railway from the town of Wandsworth to the town of Croydon, with a collateral branch in the parish of Carshalton." This being the first of the long progeny of railways, it is worth recalling that the length of the line was to be nine miles, and its cost about £60,000. Horses supplied the motive power, and the railway was not intended for the conveyance of passengers. The Stockton and Darlington Railway, opened in 1825, was the first line upon which locomotive engines were used as the moving power, and was also the first railway carrying passengers.

The most important of the earlier railway enterprises was, however, the Liverpool and Manchester line. Its prospectus was issued in 1824, but owing to the opposition

of the landowners through or adjoining whose estates the railway was to be laid, the necessary Act of Parliament was not obtained until two years later. It was while under examination before a Committee of the House of Commons concerning this project, that George Stephenson, in answer to a question whether it would not be an extremely awkward circumstance if a cow were to stray upon the line, and get into the way of an engine, made the memorable reply—"Yes, very awkward for the 'coo.'" This railway, which is regarded as the first truly passenger line, was opened on September 15, 1830, and it was thus conclusively demonstrated that steam traction on railways was feasible. Many amusing anecdotes might be told of all the dire consequences which were anticipated by high and low as the result of railways; and Mr. Ruskin, in his recent letter in which he describes railroads as "the loathsomest form of devilry, animated and deliberate earthquakes, destructive of all wise social habit," only echoed, in language more forcible than choice, sentiments which were widely entertained by our countrymen fifty years ago. Even so enlightened a man as Lord Brougham in writing to Macvey Napier, then editor of the *Edinburgh Review*, makes under date of September 16, 1830, the following allusion to the trial trip on the Liverpool and Manchester line:—"The folly of 700 people going fifteen miles an hour, in six carriages, on a narrow road, exceeds belief."

The new method of travelling thus inaugurated, produced so marked an economy of time and cost, and proved so clearly the practicability and efficiency of railway transit, that other towns soon took steps to follow the example of Liverpool. The year which witnessed the Queen's accession was an exceptionally active one in railway enterprises, no less than forty-two Acts being passed by Parliament for the building or extension of railways. In 1838 was opened the important line from London to Birmingham, and many others followed in rapid succession during the half century that has since elapsed; until now the whole surface of this country is intersected with lines,—running in all directions,—the aggregate length being at the present time 19,000 miles, over which are carried annually some 700,000,000 passengers, and 257,000,000 tons of goods. The rate of speed has been also accelerated; and whereas in the earlier days twelve miles an hour was considered satisfactory working, many of the trains at the present time average a speed of from forty-six to fifty-four miles an hour, and some even considerably exceed this latter rate. Not only so, but railways have now become one of the great outlets for British capital; and while from 1826 to 1836, Parliament authorised an outlay of £19,000,000, the amount now invested in British railways represents a sum of more than £820,000,000 sterling, and the annual gross receipts of the several lines total up to more than £70,000,000, of which latter sum about fifty-three per cent. is absorbed in working expenditure. All this has been achieved by the invention of George Stephenson, and by the development of the locomotive engine in modern times by such Firms as that of Robert Stephenson & Co., of Newcastle-upon-Tyne; of Thomas Peckett & Sons, of Bristol; and of Messrs. Dubs & Co., of Glasgow, the business of all three of which enterprising Firms will be found fully described under the head of "Locomotive Engineering" in the later portion of this Album.

We need not lose many words in dwelling upon the great revolution effected in our social economy by the locomotive steam-engine. Railways have, both metaphorically and literally, changed the face of the globe; they have insured for us rapidity of transit; they have opened up for all produce and manufactures a wider market than was available before; they have led to an extension of commerce, and promoted progress in every direction; they have conferred blessings alike upon rich and poor; and by linking together all parts of the kingdom, they have brought about greater inter-community of feeling, and have thus proved the harbingers of untold good.

Coinciding with the advent of the great railway movement, and equally important in its relation to trade and industry, was the application of steam-power to Transatlantic navigation.

Steamboats, it is true, had been previously employed on rivers and on the British Channel. In most of these cases, however, steam had not been the sole propelling power, but had rather done duty as an auxiliary to the sailing capacity of the respective vessels. To cross the Atlantic by the aid of steam-power alone appears to have been first mooted in 1836, but the project was looked upon almost universally as impracticable. Nevertheless, two years later the experiment was made, and on April 4, 1838, the *Sirius*, the first steamboat which ever crossed the Atlantic, left Cork, and arrived at New York on the 23rd, on the same day as the *Great Western*, which had started from Bristol on the 8th of April. Both voyages having proved successful, enterprising men were not wanting to promote similar undertakings on a larger scale. Two years later the Cunard Company commenced operations, and in 1841 the Peninsular and Oriental Steamship Company was formed. From that time to this the maritime intercourse between nations has expanded in a truly marvellous ratio. There are no two ports of any importance to-day between which frequent steam communication is not maintained. In this direction, too, one improvement has followed upon another, and it has been well observed that the steamer is an excellent epitome of the progress of the half-century. The paddle has been superseded by the screw, the compound has replaced the simple engine, wood has given place to iron, and iron, in its turn, to steel. Moreover, the consumption of coal has been reduced to considerably less than half; while the speed has, at the same time, been increased from nine knots per hour to more than double that rate. With these many advantages in its favour, steam navigation has become year by year a more powerful factor in our commercial life, and in this respect our country takes the lead by a very long way. It will help to accentuate this fact when we mention, that while the total number of steam vessels of 100 tons and upwards which navigate the rivers and seas of the world is 9,642, with an aggregate tonnage of 10,291,241, the number of those which fly the British flag is 5,712, representing a tonnage of 6,539,623; so that considerably more than one-half of the steam tonnage of the world belongs to Great Britain and its colonies. The above proportion is not much varied if we include sailing vessels; the gross tonnage for the world being then 21,508,134, of which total 11,165,092 tons are British. These figures amply demonstrate that we are the greatest maritime carrying nation in the world. Our great Steamship Companies have proved a very important factor in this connexion. The following stand out specially prominent, as among the most enterprising, and as those whose magnificent vessels may be described as so many floating palaces. We can but regret that our limited space precludes us from doing more than merely mention the names of some of the leading Companies, such as:—

The African Steamship Company.
The Allan Line.
The Anchor Line.
The Anglo-Australasian Steam Navigation Company.
The Beaver Line.
The British India Steam Navigation Company.
The Canadian Line of Steamers.
The Castle Line (Donald Currie & Co.).
The City Line to Calcutta.
The Clan Line of Steamers.
The Cunard Line.
The Dominion Line of Steamers.
The Guion Line.
The Indo-China Steam Navigation Company.
The Inman Line.
The Monarch Line.
The Natal Line of Steamers.
The National Line of Steamers.
The National Steamship Company.
The New Zealand Shipping Company.
The North Atlantic Steamship Company.
The Orient Line.
The Pacific Mail Steamship Company.
The Peninsular and Oriental Steam Navigation Company.
The Union Steamship Company.
The White Star Line.
The West India and Pacific Steamship Company.

Without the aid of these and other Steamship Companies, the development of our commerce to its

present vast proportions would have been an impossibility; they have proved a most invaluable connecting link between the mother country and our Colonies; they have brought to our shores treasures undreamed of in Eastern legends; they have given an irresistible impulse to the tide of national Art and Industry; and they have made possible the frequent intercourse between the different races and nations of mankind, from east to west, from pole to pole.

On another page will be found the history of what is probably the largest existing Firm of Private Shipbuilders in the world,—Palmer's Shipbuilding and Iron Company, of Jarrow-upon-Tyne,—who may proudly claim to have contributed much in securing for our country the unrivalled position before alluded to.

Another great invention which was also made available about the commencement of the present reign is the Electric Telegraph. On July 25, 1837, the first experiment in telegraphy was made between Euston Square and Camden Town, the North-Western Railway Company having sanctioned the laying down of wires between these two places soon after Wheatstone and Cook had taken out their patents. Other Railway Companies were not slow in appreciating its advantages, and within ten years after its introduction, 1,056 miles of telegraph had been completed in this country, while in 1847, the opening year of the new decade, some 1,300 more miles of wire were being laid. In these days of sixpenny telegrams, it is worth recalling that fifty years ago the charge for transmitting a message on the South-Western line ranged from three to nine shillings. In 1846 was formed the Electric Telegraph Company, which acquired most of the rights of the various inventors, and for a time enjoyed almost a monopoly of telegraphic communication; and subsequently all the lines were taken over by the Government.

Submarine telegraphy, the feasibility of which had been first pointed out by Wheatstone in 1840, became eleven years later an accomplished fact, by the completion of a cable connecting Dover with Calais. Other submarine lines were subsequently opened, and the year 1861 witnessed the crowning achievement in the successful establishment of telegraphic communication between the Old World and the New.

In this branch of science, too, there has been no standing still; the marvellous systems of duplex and quadruplex telegraphy have been introduced within recent years, allowing two or four messages to be sent along a single wire. As illustrating the present high state of development of the system, we may mention that our telegraphs have been stated to extend now over more than 150,000 miles of wire. The number of telegraph offices in the United Kingdom is more than 6,000, and the number of messages annually delivered exceeds 40,000,000 or more than one for each inhabitant—a far greater ratio of telegrams to heads of population than is shown by any other country.

We have thus traced briefly the rise and development of the three agencies which have strongly marked the Victorian Era, and which have contributed more than anything else to the unprecedented development of native industry, as well as to the extension of our means of inter-communication at home and abroad. With the advent of Railways, Steamships, and Telegraphs, a new era dawned for our country and for its unrivalled resources; and under the beneficent influence of the genius of British enterprise, a tide of prosperity was ushered in, which has benefited all ranks and classes of the community. If we have dwelt somewhat longer upon this particular aspect of the subject than we otherwise should, it is by reason that this period forms, so to speak, the turning point in our Commercial annals.

Photography again, which has placed within our reach the power of recalling and reproducing in permanent form the outline and expression of everything around us, is an art the birth of which, for all practical purposes, has been witnessed during the past half-century, and evidence of the perfection to which the art has now been brought, is afforded in these pages

under the head of "Art Photography," where an illustration gives practical demonstration of this fact. As connected with another branch,—the science of Acoustics,—allusion may be made to the Telephone, the Microphone, and the Phonograph, three inventions of but recent date which have already, and more especially the first-named, proved of immense advantage to the commercial community. We might go on filling pages with brief allusions to other important inventions and discoveries made within the period which this volume seeks to commemorate. The number of improvements made in connexion with machines alone, for instance, is legion. Automatic or self-acting tools are in the main the outcome of the last fifty years, and they form now one of the most essential elements in our textile factories, and in our workshops for the manipulation of metals, wood, and every other kind of material. What has been accomplished in these various directions is well told in some of the following articles, which recount modern feats of engineering skill relating to many different branches of work, and all evidencing the mighty conquests of Mind over Matter achieved by our prominent Leaders of industry. All such improved machines may be regarded as so many well-springs of civilisation, which, while they have enabled us to maintain our manufacturing supremacy, have also materially benefited the millions of workers by freeing them from the hardest drudgery of toil. Not only so, but the quality and finish of our manufactures have been greatly improved thereby, as is clearly shown by a comparison of the productions of five decades ago with those of the present day. The changes effected in our home surroundings, for example, are truly astounding. Our modern carpets and floorcloths, furniture, wall-papers, and textile hangings; pottery, glass, silver and electro-plate tableware; no less than the articles of personal adornment, such as dress fabrics, clothing materials, linen, jewellery, &c., have little in common except in name with those in general use fifty years ago. Both in character and design they have been vastly improved, and the social influence of decorative art and art workmanship has permeated well-nigh all ranks and classes, and is making its impress more and more upon our national character. The reader of the following pages will find striking confirmation of the marked advance which has been made in these several directions, in the articles devoted to the respective branches of industry.

This brings us to speak of the impetus given during the period under notice to the arts of Design and Workmanship. As indicative of the low ebb to which Art had fallen in this country, we cannot do better than quote from the Report of a Select Committee of the House of Commons which had inquired into the subject, and had arrived at the conclusion that "from the highest branches of practical design down to the lowest connexion between design and manufactures, the arts have received little encouragement in this country." This was in 1836, and in the following year was opened at Somerset House the first School of Design. For some years, however, very little progress was made, and the influence of the newly-constituted "Council of the Government School of Design" was confined to the very narrowest circle, and had no appreciable effect upon any of our industries. There was but little method in the system of Art education which had been adopted, and its almost utter uselessness became in the course of years more and more apparent. To Albert the Good is due the initiation of a movement which marks the turning point in the art culture of the nation during the present century—we refer to the Great Exhibition of 1851. It was an undertaking of unparalleled magnitude, and one whose beneficent influence has proved of a very far-reaching character. From the very inception of the project the Prince Consort took a most active personal interest in its realisation. He saw clearly the advantages which would accrue to this country from the friendly international rivalry thus called into existence. The whole progress of the Arts and Industries up to that time was illustrated in the Exhibition, and the magnificent display formed, in the words of a speaker of the period, a "University of the Material Arts." The lessons there taught were not thrown away

upon our countrymen. Our inferiority in the matter of art and design was brought home to us, and we soon set about remedying a state of things which seemed to threaten our manufacturing greatness. The influence of the Exhibition of 1851 upon industrial progress cannot indeed be over-estimated; for indirectly it laid the foundation of many of the art industries which are now contributing materially to our prosperity. It was, in the words of the Queen, a "Peace-Festival, which united the industry of all nations of the earth." This fairy palace in Hyde Park, with its marvellous display representing a value of two millions sterling, was indeed a sight to be remembered; and we can all enter into the spirit which prompted Her Majesty to refer, in Her diary, to the opening day as a unique event, which "can bear no comparison, from its peculiarity, beauty, and combination of such different and striking objects." The Exhibition proved in every sense what had been prognosticated a year before its opening by the Prince Consort in the following eloquent words:—"The Exhibition of 1851 is to give us a true test and a living picture of the point of development at which the whole of mankind has arrived, and a new starting point from which all nations will be able to direct their further exertions." The noble example then set in fostering and encouraging Art and Industry, has ever since been widely followed by every member of the Royal Family; and the devoted labours of Her Majesty and the lamented Prince Consort have their best and lasting memorial, in the marvellous development which has since taken place in our Natural and Manufacturing resources. Numerous as has been the progeny of its successors, the World's Fair of 1851 will ever stand out as the great turning point in our industrial career; and not a few of the Firms whose history is recorded in these pages, can trace back their origin or their rise to a more prominent position to about this period.

Recognising as did the Prince Consort the importance of art as applied to industry, and the great deficiency of our designers and artisans in this direction, he at the close of the Exhibition enlisted the sympathy of the Ministry of the day in an effort to reform the schools of design. The following year witnessed the realisation of this project, and thus was laid the foundation of the Science and Art Department, which through its various agencies has ever since exercised an important art-educational influence upon native industry. The extension of the operations of the Department will be apparent from the fact that while in 1852 there were only 20 schools of art with 5,000 scholars, there are now more than 200 schools, with an attendance of some 40,000 pupils; while the total number of persons who receive instruction in Art in some form through the agency of the Department called into being at the instance of the Prince Consort, is now about 900,000.

So many are the subjects crowding upon us as worthy of a passing notice in this short summary, that we must pass on. Popular education, too, was sadly neglected at the time of Her Majesty's accession, and it was not until two years later, in 1839, that the Council on Education was called into being. Since then giant strides have been made in both primary and secondary education, and the Government grant of £20,000 for educational purposes of fifty years ago, has since increased to nearly £4,000,000 per annum. The Education Act of 1870 of course greatly helped forward this movement; the number of primary schools since that year alone having increased from 11,000 to 22,000, and the number of children attending from 1,547,000 to over 4,000,000.

Postal Reform also falls within the past half century, as Rowland Hill's proposal on the subject was only made public in 1837, and carried into effect in the beginning of 1840. The result of the new system of uniform postage was almost magical; the number of letters passing through the Post Office, which had been 76,000,000 in 1839, rose in the following year to 169,000,000; while in 1885–86, the total was 1,403,547,900, thus giving now an average of thirty-nine letters for each

head of the population, as compared with three in the year preceding the introduction of the penny postage system. From another point of view the importance of this reform is equally striking. When Her Majesty's reign commenced, the postage of a "single letter," as it was termed, viz., without enclosures, sent from London was as follows:—To Birmingham, ninepence; to Manchester, elevenpence; to Newcastle-upon-Tyne, one shilling; and the latter amount was considerably exceeded in the case of letters transmitted to Scotland and Ireland, the postage to which ranged from fourteenpence to eighteenpence. In the case of so-called "double and treble letters," two and three times the above sums had to be paid; but if the letter weighed an ounce, it was "to be rated as four single letters," so that the transmission of such a note to Stromness, for instance, cost 6s. 2d.! Foreign postage rates were proportionately high, and we remember Mr. John Bright mentioning some years ago that he had paid twenty-five shillings for the postage of a single letter sent from Leghorn in Italy. But if the charges were high, the postal service on the other hand was bad; there were only two mails a week to Holland, Germany, and the North of Europe, and one mail a month to the United States, the Mediterranean, Egypt, India, and most other foreign parts. The changes effected since then are too familiar to every business man for us to enlarge upon them here.

All this has, in turn, had a marked influence upon our Commercial Progress—a subject to trace the development of which would in itself be sufficient to fill this volume. Few of the present generation have probably an idea of the vexatious nature of the Customs Tariff in force in 1837. It enumerated no less than 1,150 different articles upon which import duties were levied, and it is amusing to recall the pains that were taken to prevent even the most insignificant articles from escaping through the meshes of the Customs' net. In its anxiety to foster and nurse British industry, Government had imposed an import duty even upon pill-boxes and corks! Sydney Smith's witticism about taxes being levied "upon everything which it is pleasant to see hear, feel, smell, or taste,—taxes on everything on earth and the waters under the earth," was indeed nothing but a fair description of the state of things which then obtained. It is not our intention to trace the origin of the Anti-Corn Law agitation and the Free Trade movement. They are matters of general history. Under the old *régime* the burdens, restrictions, and delays imposed upon the trade and prosperity of the country were innumerable. To dwell upon these would, however, answer no practical purpose; we would rather here accentuate the rate of development which has taken place in our Commerce since these restrictive burdens were removed. In 1837 the value of British manufactures exported was £42,070,000; while the total for last year amounted to £212,364,000—even which latter sum, be it remembered, had been exceeded in previous years by over twenty million sterling. Of foreign produce we imported in 1837 to the value of £54,737,000, and the corresponding total for 1886 was £349,381,000. Although these imports do in some branches affect our home industries injuriously, still it is well to bear in mind that out of the above total about £143,000,000 represents the value of food imports, for which we are largely dependent upon foreign countries; while the cost of raw materials for the metal, textile, and other trades absorbs a further sum of £122,000,000. The value of manufactured articles coming to this country from abroad represents on the other hand not quite £54,000,000. This sum, it will be acknowledged, is comparatively small when placed in contrast with the £190,000,000 worth of goods wholly or partly manufactured in the United Kingdom which were exported last year. It is nevertheless a question for our manufacturers whether we, who can find a market for our goods in well-nigh every part of the globe, ought to import manufactured articles even to the minor amount above stated. However that may be, despite hostile tariffs and other impediments thrown in the way of our Commerce, we occupy still an unrivalled and unique position in the markets of the world. Our aggregate imports and exports are more than double

the value of those of any other nation; or to put it in another way, our foreign trade shows an average proportion of £17. 13s. per head of population of the United Kingdom, while that of our leading competitors has been computed as follows:—France £7. 18s., Germany £6. 17s., and the United States £5. 3s. This is an achievement of which we may well be proud, proving as it does that by skill and energy our manufacturers and merchants have continued to extend our foreign commerce, and to find remunerative employment for British capital and industry. This brief survey of our leading Industrial and Scientific advancement brings us of necessity to speak of our "Financial Organisations," viz., the vast Joint Stock as well as Private Banking establishments, many of which have been called into existence during the last fifty years. It is not too much to say that, had it not been for the financial aid which these Institutions have given to all that has tended to the expansion of legitimate commerce, many of the greatest improvements and inventions of recent times would probably have never seen the light of day. We have given a brief sketch of three great City Organisations, but we know there are many others of equal commercial importance, which our limited space precludes us from even mentioning merely.

Agriculture, again, is a subject that has during late years come prominently to the front; the heavy and increasing imports of grain and animal food from abroad, and the consequent depression in prices, have in many cases proved disastrous to native enterprise. The future of British Agriculture is happily engaging the attention of our leading statesmen, and it is to be hoped that some means may be found of reviving this once highly flourishing industry. Meanwhile, however, the application of machinery is proving an important factor in connexion with the cultivation of land, and how successfully British enterprise and ingenuity have come to the aid of our farmers with agricultural machinery, by the use of which great economy is effected, is fully told in the article descriptive of the business of Messrs. Ransomes, Sims, & Jefferies, of Ipswich.

Increased wealth and enjoyment have been brought within the reach of all classes, and it would be easy to show that every section of the community is better housed, better clothed, and better fed to-day than was the case fifty years ago. The artisan population, especially, has been materially benefited. Wages have been raised considerably, and the hours of labour have been at the same time materially shortened. Special legislation has, moreover, come to their aid, and the various Factory Acts, the Employers' Liability Act, and many other measures, have been passed in their interest. Public sanitation has also received increased attention, and its essential conditions are better understood now than they were formerly. Well-devised systems of drainage have been introduced in most of our leading towns, and provision has been made to insure to the population a plentiful supply of pure water. Indeed, considerably over £100,000,000 has been spent within the period in question on sanitary works of various descriptions, and thus the moral as well as the physical condition of the nation has been greatly improved. The death-rate has been considerably lowered; epidemics have become rarer, and when they do occur are far less virulent than they were formerly. To put it in few words, the advantages which the present generation possesses over that of the past are—improved health, increase of years, and a more intellectual and higher state of existence.

The marked diminution of crime which has been noticeable during recent years is a hopeful sign of the times, and may be regarded as the outcome of more general education and wiser legislation. The first year of Her Majesty's reign was signalised by an important reform in our system of criminal jurisprudence. By an Act passed in 1838 the penalty of death was removed from several of the largest classes of offences, for which up to that time executions had not been unfrequent; and three years later the law was still further ameliorated in the same

direction. In this connexion it may not be out of place to mention that in the very month of Her Majesty's accession the degrading punishment of the pillory was abolished, the Act having received the Royal sanction on the 30th June, 1837. During the period that has since elapsed, the number of committals for trial to the sessions or assizes shows a reduction of sixty-nine per cent. It must, however, be borne in mind, apropos of this, that a great number of cases which were formerly sent for trial have since 1855 been summarily disposed of by magistrates. The number of paupers, it is worth adding, is smaller to-day than it was fifty years ago, despite the fact that the population has increased during the half-century from about 25,000,000 to nearly 37,000,000.

Literary activity, truly unparalleled in its fecundity, has been another characteristic of the Victorian Era, and every department of knowledge has been enriched by contributions, many of which have exercised a lasting influence upon our national life and character. History and biography, poetry and travels, science and art, fact and fiction, have all contributed largely to the instruction and amusement of the community, and the stream of literature issuing from the press is incessant, having increased from some 1,350 new books fifty years ago to 5,210 in 1886. Still more remarkable has been the development of periodical literature. The abolition of the newspaper stamp, the advertisement duty, and the paper duty, have all helped materially to develop the Fourth Estate. Numerically, the Newspaper Press shows the marvellous increase from 370 in 1837, to 2,135 in 1887; and the number of magazines has risen from 320 to 1,462. The price of a newspaper fifty years ago, handicapped as it was by taxes representing many times its actual cost, was prohibitive, and comparatively few persons could afford to spend sevenpence on a paper. What was then looked upon as a luxury has now, however, come to be regarded as a daily necessary, and its present price places the news-sheet within the reach of all classes. For freshness, for vigour, for originality, and for variety, the British Newspaper Press stands unsurpassed. On another page is told the history of the *Times*, the leading journal of Europe, whose career for enterprise, boldness, independence, ability, and liberality, is in many respects typical of that of many of its competitors. Did space permit, we could have wished to trace the rise and progress of the other great organs of public opinion, such as the *Daily Telegraph*, established in 1855 as the first penny daily, which has since acquired a reputation second to that of no other journal; the *Standard*, started as an evening paper in 1827, and converted into a morning paper thirty years later, and the first journal which published a double sheet, viz., eight pages, at the price of one penny; the *Morning Post*, the *doyen* of London dailies, its origin dating back more than a century, viz., to 1772, and whose columns combine fashionable intelligence with political and general news; the *Daily News*, a journal of great prestige, which at its first starting in 1846 had Charles Dickens for its editor; the *Daily Chronicle*, which while in one sense the youngest of our dailies, has already secured for itself a high standing and a recognised position; and, lastly, the *Morning Advertiser*, a paper nearing the centenary of its existence, and with the exception of the *Times* the only London daily published at threepence. Of evening papers we have the *Globe*, the *Evening Standard*, the *Pall Mall Gazette*, the *St. James's Gazette*, the *Echo*, and the *Evening News*. Of each of the foregoing papers it may be truthfully remarked that for impartiality of tone, and for conscientiousness of opinion, they may vie with the Press of any other country; while they are no less remarkable for the ability and sober judgment with which they are edited, and the fulness and accuracy of their information. The literary matter, in the form of leaders, reviews, &c., to be found daily in these papers, and in many of the leading provincial organs, gives evidence of the rare erudition and profound scholarship of their respective staffs of writers.

From Literature the transition to the Fine Arts is natural, and the humanising power of

this agency of culture is asserting itself more and more in both public and private life. The English School of Painting now occupies a recognised position, while in some branches of the art, and notably in water colours, our artists stand probably unrivalled. In Science, again, not only has there been a great advance in all its various sub-divisions, but this branch of knowledge has been greatly popularised, and in many of its aspects it is now the heritage of the million instead of the exclusive property of the few. The progress in Music has also been most encouraging, and the Royal Academy of Music, the Royal School of Music under the patronage of the Prince of Wales, and the Guildhall School of Music, are all flourishing institutions, adapted respectively to the needs of the general and the professional classes.

Thus we might go on recounting the numberless changes in our social, moral, and intellectual life, which the past fifty years have witnessed, and to describe all the various beneficent agencies which have been instrumental in placing us at a height of commercial prosperity that has made this country the emporium of Europe,—the chief centre of the Commercial World. We have in the few preceding pages touched but the very fringe of the subject; and the points upon which we have dwelt are few when compared with the vast mass that have been left unconsidered. The pages which we have filled remind us, however, that we must bring this article to a close, so as not to outrun the space allotted to this introductory chapter. Our brief retrospect has been mainly confined to the Commercial and Industrial Progress of the Half-century, in order to give the key-note to the subsequent division of this Work.

That the industry, enterprise, and integrity of our great Manufacturers and Merchants have laid the foundation of our national prosperity, and have built up the vast edifice of our commerce, with its ramifications all the world over, admits of no question. It is the object of the present Work to tell how the vast natural resources of this Kingdom have been turned to account, and how by individual effort, aided by mechanical invention, scientific discovery, and the most perfect of industrial appliances, our present Commercial supremacy has been attained. The reader of the following pages will acknowledge that our great Leaders in the Arts of Peace have proved true benefactors to their kind, by adding to the happiness of the individual and to the well-being of the community. Here will be found recorded episodes and incidents of the most interesting and instructive nature, and biographical data concerning many of the traders who have helped forward the modern progress of civilisation, culture, and refinement. Quaint old Fuller observes that "The good merchant is one who by his trading claspeth the islands to the Continent, and one country to another; an excellent gardener, who makes England bear wine, and oil, and spices; yea, herein he goes beyond Nature, in causing that *omnis fert omnia tellus*." Thanks to British energy, in one sense the above motto now holds true, and "every land bears everything"; foreign countries being supplied from our workshops with thousands of necessaries and luxuries, adapted to the varying requirements and tastes of every nation.

A glance through these pages will show that there is amongst us, in the words of Carlyle, "an unrecognised Noblesse of Commerce," and it has been our aim to fill an existing gap by supplying here a special Muster-roll of some of the Famous Men of Commerce and Invention—to supply a Work which shall contain descriptive sketches of many of our great hives of industry, and of the Firms who may rightly claim to take the lead in manufacturing enterprise. In one or two cases we have departed from the general rule of confining our attention only to Productive Industry, our reason having been that to ignore altogether the gigantic retail houses, which combine under one roof almost every branch of commerce, would have been fatal to the completeness and representative character of this volume; and the business houses under

the latter category which we have selected for notice, have become almost national institutions rather than mere private enterprises.

Thus, then, we have briefly traced the stream of National Progress, which latter in itself bears evidence to the happy and prosperous reign, the Jubilee of which this Volume seeks to commemorate among all English-speaking Nations. Her Majesty's personal influence has throughout been marked by everything that is ennobling and elevating; and the Triumphs of Industry here recorded, have in no small degree been rendered possible by the efforts of the Empress-Queen and of the other Members of the Royal Family to second every movement that could conduce to the development of the industrial and commercial resources of the country. In bringing this opening chapter to a close we would apostrophise Her Majesty in the well-turned lines addressed just three hundred years ago to her great predecessor, Queen Elizabeth, some of the references being, we think, specially appropriate to the contents of this ROYAL ALBUM OF ARTS AND INDUSTRIES:—

Most gracious Prince, undoubted sovereign Queen!
Our only joy, next God, and chief defence!
In this small Show our whole estate is seen;
The wealth we have, we find proceeds from hence:—
The idle hand has here no place to feed,
The painful wight has still to serve his need.

We bought before the things which now we sell;
These busy Hives,—their works do pass the waves:
God's peace and thine we hold, and prosper well,
Of every mouth the hands the charges saves;
Thus through thy help and aid of Power Divine
Doth Britain live, whose hearts and goods are thine.

FINANCIAL ORGANIZATIONS.

The Bank of England.

THIS establishment, now the synonym for safety and security, has, like many companies had a somewhat chequered career. It was projected by William Paterson, and incorporated by charter in the year 1694. This charter was granted for only twelve years, terminable at one year's notice, in consideration of a loan of £1,200,000, for which 8 per cent. and a bonus of £4,000 for management was paid. From time to time the charter was renewed, first for five years, and subsequently for twenty, ten, forty, twenty-five, and twenty-one years respectively, generally in consideration of further loans. In time the indebtedness to the Company amounted to some £12,000,000 on account of the permanent debt, interest on which fell to 3, 3½, and 3¼ per cent.; but besides this, temporary advances have been made in anticipation of taxes and on Exchequer and Treasury Bills.

The income of the Bank arises from the interest on the permanent debt, an allowance for its management, and the payment of dividends on the public Funds, also for advances on Exchequer Bills, and for receiving contributions on loans. To these must be added the interest on Stock held by the Company, the discounting of Bills of Exchange, and the dealing with bullion or foreign coins, as well as the ordinary profits derived simply as Bankers.

These charters invested the Bank with several special privileges. The Governor and Company are by them authorised to purchase and retain lands, &c., to borrow money under their common seal or upon their capital stock, whilst they are protected within a limited area by the prohibition of other companies from borrowing on their notes for a less period than six months. But the statutes by which they were incorporated restrain them from trading with any of their effects in goods or merchandise, unless they be such as are mortgaged to them, and not redeemed after a period of three months beyond the time stipulated for redemption.

The solidity of the resources of the Bank and its initial wealth are thus fixed upon so permanent a basis that Bills of Exchange can be procured in all parts of the world for its notes on the same terms as for specie, and in ordinary times it has been calculated that the chance of loss is only the remote contingency represented by one in 300,000.

The principal vicissitudes of this great financial institution are as follows:—In 1696, only two years after its establishment, difficulties arose owing to scarcity of specie, and its notes were at 20 per cent. discount, and these were only overcome by an Act of Parliament authorising an increase of capital. In 1745 a run on the Bank was caused by the rising in Scotland in the interest of the Pretender, who had advanced at the head of a body of Highlanders to the midland counties. To meet this the Governor and directors hit upon an ingenious plan to gain all they wanted—"time," and paid their notes in small silver coinage requiring a long time for counting; meantime the great mercantile body met and agreed to accept bank-notes for payment. Charles Stuart was defeated and confidence restored, but the Bank was saved by a

ruse. During the riots of 1780, the Bank was threatened by the mob, and only escaped by calling to its assistance a military force, and thus originated the existing system of a nightly guard from the Tower. In the year 1797, and to the end of the Napoleonic wars, owing to the state of national affairs, the advance in the price of gold, and its continued exportation, the quantity of specie held against notes was so much reduced as to render suspension of payments in cash necessary, which was done by an Order in Council, renewed annually during that period, so that it was only in 1819 that the sound principle of retaining a safe proportion of metallic currency against notes was returned to and specie payments were resumed. The amount of the notes now in circulation exceed the specie reserve by about £16,000,000, which is, however, covered by other securities.

In 1844 an Act of Parliament was passed which, *inter alia*, limited the issue of notes to £14,000,000, subsequently increased to over £15,000,000, in addition to the amount of bullion or specie in the vaults of the Bank; these together, as a rule, justified a circulation of about £30,000,000, although in 1879 it amounted to about £33,250,000 millions; but, in the years 1847, 1857, and 1866 the drain of metals was so large that, to avoid the contraction of note issue, and the consequent withdrawal of the media provided by note circulation, the Bank Act, limiting the issue, was temporarily suspended. At present, the great influence of the Bank has been shown in no case more than its power of practically arranging the rate of discount for commercial securities; and the publication of any alteration arranged by the Directors not only affects like transactions by other banks and discount companies, but also indirectly affects the value of securities, as indicating the condition of the Money Market and the state of trade. It may be asked, What were the profits of so exceptional, although we have shown by no means a consistently prosperous, society? In 1837 the dividend on Bank Stock was 8 per cent., and the value of the Stock ranged between £203 and £212. For some fourteen years after it paid only 7 per cent., but Stock slightly increased in value. From that period to the present time dividends have ranged from 8 to 12 per cent., and the value per £100 Stock has reached nearly £300.

The management of the Bank consists of a Governor, Deputy-governor, and twenty-four directors, who are annually elected by the proprietors from their body, the qualification for Governor being £4,000 Bank Stock; Deputy-governor, £3,000; for a director, £2,000; and for an elector, £500, which must have been held for six months, unless by bequest or inheritance. Foreigners are disqualified from being proprietors.

The present staff consists of:—

Governor—MARK WILKS COLLETT. *Deputy-Governor*—WILLIAM LIDDERDALE.

Directors.

HENRY WOLLASTON BLAKE.
JOHN WILLIAM BIRCH.
HENRY COSMO ORME BONSOR, M.P.
HERBERT BROOKS.
WILLIAM MIDDLETON CAMPBELL.
ROBERT WIGRAM CRAWFORD.
JAMES PATTISON CURRIE.
SAMUEL STEWART GLADSTONE.
BENJAMIN BUCK GREENE.
HENRY RIVERSDALE GRENFELL.
HENRY HUCKS GIBBS.
JOHN SAUNDERS GILLIAT, M.P.
EVERARD ALEXANDER HAMBRO.
THOMSON HANKEY.
HENRY LANCELOT HOLLAND.
RIGHT HON. JOHN G. HUBBARD, M.P.
SAMUEL HOPE MORLEY.
EDWARD HOWLEY PALMER.
AUGUSTUS PREVOST.
DAVID POWELL.
ALFRED CHARLES DE ROTHSCHILD.
ALBERT GEORGE SANDEMAN.
ALEXANDER FALCONER WALLACE.
CLIFFORD WIGRAM.

Secretary—HAMMOND CHUBB.
Chief Accnt.—SAMUEL OCTAVIUS GRAY.
Chief Cashier—FRANK MAY.
Deputy—GEORGE FREDERICK GLENNIE.
Deputy—HERBERT G. BOWEN.
Deputy—EDWARD E. BALY.
Assistant—JOHN HERBERT BOWMAN.
Assistant—GEO. FRED. STUCHBURY.
Assistant—THOS. ASKWITH.

DISCOUNT OFFICE. *Principal*—GEO. A. DREVAL. *Deputy*—H. W. SEARCH.

BRANCH BANKS' OFFICE. *Principal*—EDWARD MOULAS COURTNEY. *Deputy*—W. H. MILLETT.
Solicitors—MESSRS. W. & E. FRESHFIELD. *Architect*—ARTHUR WM. BLOOMFIELD. *Medical Officer*—JOHN A. KINGDOM.

WESTERN BRANCH, BURLINGTON GARDENS. *Agent*—SIR ARTHUR N. BIRCH, K.C.M.G. *Sub-Agent*—C. W. BAYNES.

LAW COURTS BRANCH. *Agent*—L. D. FINNEY. *Sub-Agent*—W. T. LANGFORD.

THE FOLLOWING ARE THE COUNTRY BRANCHES:—

Manchester *Agent*—G. W. MOULTRIE. *Sub-Agent*—R. T. HADON.
Liverpool ... „ T. R. STOLTERFOLT „ T. F. A. AGNEW.
Birmingham „ F. F. BARHAM ... „ M. A. SHEE.
Bristol ..... „ F. HOWARD ..... „ WALTER NISBET.
Leeds ..... „ R. B. TURNER ... „ C. D. MACARTHY.
Plymouth ...*Agent*—H. H. TREMAYNE. *Sub-Agent*—R. T. WEST.
Newcastle-on-Tyne ..... „ F. B. FAIRLEY ... „ W. B. MOLYNEUX.
Hull ..... „ G. R. LEMPRIÈRE... „ H. A. N. SMITH.
Portsmouth „ H. S. J. ROSS..... „ G. C. EVELEGH.

Lloyds.

PARTNERSHIPS in the risks attendant on sea ventures are as old as the time of the Cæsars, and were developed into a more or less defined system by Venetians and Genoese long before they were known in this country; but it was not until the reign of Queen Elizabeth that the custom of marine insurance was moulded into shape. In 1601 we hear of policies made in Lombard Street, and a policy dated in 1613 is still extant.

The underwriters who subscribed these early documents were at that time bankers, money-lenders, or opulent merchants, who, at their own offices, took risks as pure speculations independently of their regular business. On the establishment of coffee-houses in London, those interested in marine adventure frequented one owned by Edward Lloyd in Tower Street, and formed themselves into a regular body in 1692. Mr. Lloyd removed his coffee-house to Lombard Street, where they became, in 1770, an organised Society, under the title of Lloyds, and, after a short sojourn in Pope's Head Alley, removed, in 1774, to their present quarters, the Royal Exchange.

Two circumstances during the period we have mentioned deserve notice: First, the publication by Mr. Lloyd of a periodical, called *Lloyd's News*, so early as 1696, which was issued with a sheet of writing-paper attached, so that merchants and others could send the news with their letters to their correspondents; from some cause, not very well known, Mr. Lloyd ceased the publication for thirty years, and, when re-issued in 1726, it was in the form of the now historical *Lloyd's List*, which has greatly assisted in the conduct of the business. The other circumstance was of a different character, but no less important. When the underwriters as a body were but newly formed, they had to meet the difficulty of obtaining suitable premises for their growing numbers; and various plans were under the consideration of leading operators, but without success, when Mr. John Julius Angerstein obtained, on his own responsibility, possession of rooms in the then Royal Exchange in the year 1774. This gentleman (of foreign origin), by far-sightedness and marked ability, greatly influenced the development of the institution.

Whilst the Society was thus in course of formation, in the year 1720 two rival companies obtained charters of incorporation for the purpose of entertaining marine insurance risks, more from the adventitious circumstances of Court influence and Crown necessities than from any inherent merit, and this in face of strong opposition from private underwriters. The disputes consequent thereupon, although of great interest, are somewhat foreign to our present notice. Suffice it to say that, in practice, owing to the large increase in the commerce of the country, there is ample room for Lloyds, as well as for the London Assurance and Royal Exchange,—the two corporations alluded to.

The next matter of importance affecting the Society reads more like a chapter in a sensational novel than the record of mere history, but it was of the most essential importance to them. Who has not heard some account of the loss of the *Lutine* frigate in 1799, but how many have heard a really true relation of the tale?

Shorn of the wonderful exaggerations that have emanated from various sources, the facts may be thus shortly stated:—The *Lutine*, a frigate built in 1785, was taken from the French under the name of *La Lutine*, and formed one of the North Sea squadron under Admiral Duncan. At that time this country was at war with Holland and France, and our armies in the Netherlands required large amounts of money, which vessels of the fleet conveyed for greater safety. Many leading bankers and merchants gladly availed themselves of these opportunities, and, by permission of the Admiralty, shipped specie and coins to their correspondents by such means; and at this time a large amount—about £150,000—was awaiting conveyance to Hamburg (not to Texel), and Admiral Duncan appointed the *Lutine* for the service. The money was put on board in Yarmouth Roads on October 8, 1799, and on the 9th or 10th she was lost, with all hands except one, who died shortly after. Netherlands fishermen, between June 1, 1800, and November 1, 1801, succeeded in recovering some £80,000, which was confiscated, and at the last-mentioned date all trace of the vessel was lost. Meantime, underwriters had settled and paid the loss with their usual promptitude, and had forgotten all about it.

It was not so with others, and a Mr. P. Eschanzier, in 1814, obtained from the Dutch Government a sufficient sum to make an attempt to raise the cargo, which he asserted, from certain marks and numbers on the portion first saved, was of considerable amount, at least £100,000,—a calculation subsequently verified. It would exceed the limits of our space to detail the various failures or insignificant successes of different expeditions which followed; but in the years 1857–8 £40,000 was recovered, and from 1859 to 1861 some £5,000 more, besides the bell and rudder of the vessel, the one being adapted as an ornament, and the other converted into a stately chair and a table, may be now seen in the library of the establishment. The division of the saved treasure was, of course, the subject of much diplomatic and commercial contention: salvors had to be paid and rights to be assessed, but at the present time some £40,000 is in possession of the Society, and forms the principal part of their capital.

Whilst Lloyds had thus obtained so unexpected and substantial a basis, the members have, during the last fifty years, by their own efforts and liberality, extended their influence in every direction, establishing agencies for the assistance alike of maritime and mercantile interests in every port in the world, and instituting methods for the collection and diffusion of information—postal and telegraphic—that are unrivalled; nor have they been merely guided in their action by business considerations, as has been evidenced by their generous and consistent support of the measures taken for saving life at sea, and their keen interest in the developments of the Life Boat, the Rocket Apparatus, and other contrivances to that end, and they have been indefatigable in the unearthing and prosecution of the numerous frauds connected with marine adventure. But, perhaps, their growing influence has nowhere proved more beneficial than in the part they took in the establishment of the Society called Lloyds' Register of British and Foreign Shipping.

Of course, they have also experienced, in common with all great societies, domestic difficulties. At one time, the financial position of many of the members caused anxiety. This was remedied by requiring the material guarantee of £5,000 from every new member, to be held in trust against his account.

Thus, with wealth, growing influence, and extended operations, the members of Lloyds not unnaturally thought that they were ripe for incorporation with extended powers, and in May, 1871, the royal assent was given to an Act of Incorporation.

The Corporation is under the management of twelve committeemen, the present members being:—

The Right Hon. GEORGE HENRY JOACHIM GOSCHEN, M.P., *Chairman.*

CHARLES WILLIAM HARRISON.	MORRIS BECK.	ARTHUR O. WILKINSON.
FREDERIC R. BERNARD NATUSCH.	LEONARD CHAS. WAKEFIELD.	ROBERT BRADFORD.
CHARLES ALEX. HARDMAN.	HENRY NIXON.	JOSEPH EDWARD STREET.
WILLIAM HENRY TINDALL.	GERARD FRED. MILLER.	WILLIAM ELLIOTT.

HENRY M. HOZIER, *Secretary.*

And as three go out by rotation every year, there are always that number who have served and are eligible for re-election after one year's interval. The gentlemen now in this position are—

MARMADUKE HART BROOKING. JAMES L. WYLIE. MICHAEL WILLS.

The number of members of Lloyds is nearly 700, of which about 450 are entitled to underwrite, and about 650 subscribers. There are also British, foreign, and colonial societies and companies who subscribe, to the number of about forty. The following are some of the leading members:—

Adams, John.
Adams, John Franklin.
Adderley, John Augustus.
Alfrey, Alexander.
Alfrey, George.
Alfrey, John Octavius.
Allsopp, Major Hon. W. H.
Allsopp, Franklin Thomas.
Andrae, John Charles.
Anderson, J. G. S.
Anderson, John Charles.
Ansted, Charles.
Arbuthnot, W. Reierson.
Archer, Walter E.
Atkins, H. S.
Aukland, John Loxley.
Badderley, Samuel.
Basden, W. Macdonald.
Bathe, W. Cameron.
Bawtree, Samuel.
Beauchamp, Edward.
Beck, Francis.
Beck, Gilbert Francis.
Benecke, C. Victor.
Benecke, Otto August.
Bevington, Alexander.
Bilborough, Arthur.
Bishop, H. D.
Bonus, Henry.
Borwick, Alfred.
Bowring, G. E.
Bradford, Nicholas.
Bradford, W. Arthur.
Buisson, T. Du.
Brand, James.
Budd, F. Llewellyn.
Bullen, George.
Burnand, Arthur.
Burnand, Arthur Charles.
Burnand, George.
Burnand, Henry.
Burnand, Percy G. C.
Burnand, Theophilus.
Burrows, J. S.
Byas, W. Hegley.
Chamberlayne, Walter.
Cheesewright, H. C.
Choisy, J. J.
Churchill, John.
Cooper, E. E.
Cornnell, C. W.
Cotesworth, William.
Currie, Alexander.
Costa, Solomon J. Da.
Davison, T. L.
Dufour, Gustavus Arles.
Duncan, George.
Elias, Ellis.
Elliot, Edmund Frederick.
Faber, G. Henry.
Fenning, G. D.
Fenning, James.
Fenwick, Charles Richard.
Fenwick, John.
Fenwick, Nicholas Percival.
Finch, Arthur.
Fish, A.
Fleming, John.
Fleming, R. T.
Forwood, Arthur B.
Foster, G. Bevington.
Fox, J. Hingston.
Franks, R. C.
Fraser, James.
Friend, F.
Gibb, G.
Gibbs, Henry H.
Gilson, Edward R.
Glover, John.
Grant, John.
Green, F.
Green, Henry.
Greig, Henry Alfred.
Hankey, F. A.
Harding, William.
Harper, Samuel S.
Harris, Ernest.
Haslam, Henry.
Haycraft, W. S.
Head, Henry.
Heath, Cuthbert E.
Heintz, H. Caspar.
Hemery, Charles.
Henderson, R.
Hewitt, W. A.
Hobbs, Hugh Marcus.
Holt, G. Wells.
Holmwood, T. D.
Hoole, Stanley.
Huth, F. H.
Hyslop, Akroyd.
Janson, Dearman.
Janson, John W.
Janson, Francis W.
Jeuda, Henry.
Jupe, John.
Kennard, Coleridge J.
Kleinwort, H. G.
Lamplough, C. E.
Lamplough, Edmund S.
Lamplough, Williamson.
Lancaster, W. Locke.
Lawrence, A.
Lee, John.
Lindley, R.
Lister, G. Daniel.
Litchfield, Clayton.
Lubbock, Neville.
Luscombe, J. Henry, junr.
Lynch, J. Burke.
Macandrew, J. F.
Mackinnon, B. T.
Mackinnon, D. C.
Manley, Henry.
McMaster, James.
Marshall, W. Gore.
Martin, F. W.
Matheson, Sir A., M.P.
Melhuish, Alfred J.
Mildmay, H. B.
Milstead, J.
Moger, G. H. B.
Moore, J.
Moore, J. A. Bramley.
Morice, J. F.
Moser, Arthur.
Moser, John.
Moser, F. R.
Murrieta, Cristobal de.
Norwood, C. M., M.P.
Nugent, C.
Oliverson, T.
Parkyns, Sir T. G. A., bart.
Phillipps, R.
Pitcairn, A.
Pitcairn, John G.
Poole, Henry S.
Powell, David.
Previté, J. Weedon.
Price, C.
Price, John Davies.
Price, W. Ramsden.
Ralli, S. A.
Rasch, F. C. L.
Rawlins, H.
Redfern, W. L. M.
Reid, Neville.
Reid, Percy T.
Reiss, C. A.
Reiss, G. E. A.
Reiss, J. E.
Rennie, W.
Revelstoke, Lord.
Richards, Melville.
Richards, William.
Robertson, W.
Robinson, A. O.
Robinson, J. W.
Rodocanachi, M. E.
Rothschild, Sir Nathaniel Meyer de.
Rougemont, A.
Rougemont, D. A.
Rougemont, Herbert
Row, T.
Sandeman, A. G.
Sands, John.
Sapte, Brand.
Sapte, Cecil H.
Sapte, William.
Saunders, W. F.
Saunders, Edward.
Saville, Walter.
Schröder, J. H. B.
Schwann, C. E.
Schwann, J. F.
Scott, Charles.
Scott, A.
Scott, Philip.
Secretan, A. E.
Secretan, H.
Secretan, Holford
Secretan, L. M.
Sedgwick, H. B.
Seymour, Henry.
Shepard, R. W.
Shepard, R. H.
Simpson, C. S.
Simpson, J. M.
Simpson, M.
Smith, A. Parkyns.
Smith, Sydney.
Smith, Walter F.
Smith, W. F.
Smith, Samuel.
Steel, W. S.
Steinmetz, J. H.
Stephens, T. W
Stephens, W. A.
Symondson, W.
Tennant, C.
Tidd, F. A.
Tidd, G.
Tidd, W. R.
Tiffin, H. F.
Tod, A.
Toulmin, Calvert J.
Toulmin, F. Stockdale.
Tyser, G. D.
Town-Smith, F.
Tyser, G. W.
Tyser, W. H.
Uzelli, Theodore.
Vanner, J. E.
Vanner, John.
Vigors, T. M. C.
Walls, Andrew.
White, Stephen.
Wigram, Clifford.
Wigram, R.
Willis, John.
Willis, David.
Wilson, C. H., M.P.
Wylie, C. I.
Wyllie, J.
Young, A. N.
Young, A. W.
Young, W.
Young, W. Roubertoun.

The London Stock Exchange.

ALL European countries and leading centres in America have their bourse or exchange, but whilst we do not deny the widely-extended operations of not a few—of Paris, Amsterdam, Berlin, New York, and others—no one has yet attained to the universal and cosmopolitan character of the London Stock Exchange; and, therefore, even the short history we give of that body cannot be without interest and instruction.

Like many strong and powerful associations, the Stock Exchange has arisen from conditions little akin to its present development, and it may surprise many to be told that as a separate organised establishment it is scarcely 150 years old. It is true that previously to that period the Bank of England was by charter empowered to conduct business of a cognate character, and allowed gentlemen to deal in securities within its walls; but it soon became apparent that such transactions were too extensive, and, at the same time, alien to the proper business of banking, so that whilst they retained, and continue to do so, the discounting of bills of exchange, which were the first class of securities requiring negotiation, they gradually declined the sale and purchase of such securities as were represented by British or Foreign Government Loans and of Chartered Corporations. It thus followed that operators in the latter formed themselves into a distinct class, who, about the year 1700, located themselves in Change Alley. In 1773 they removed to Sweetings Alley, and finally purchased the house of Sir William Capel, in Capel Court, and built an Exchange, which was opened in 1802, and this has been their permanent home ever since. How both this building and the business have extended, it would take a volume, and an interesting one, too, to narrate; but it will be a fair indication of their growth when we say that the present building is perhaps one of the most extensive and noble in the City, and that its members now number nearly three thousand gentlemen.

The development of business necessarily led to the consolidation and extension of the rules and regulations by which the gradually increasing body should be governed. It was soon found that when anybody by paying sixpence could enter the Exchange, no real control could be obtained, nor could any knowledge of the financial standing of a member be ascertained beyond mere repute; accordingly, those who were most interested formed themselves into a managing body, with an elective membership, and hedged it in with stringent conditions as to character, integrity, and means. They also found it necessary to control the class of securities allowed to be quoted, and by this means afforded valuable data to investors of the *bona fides* of such societies by carefully excluding schemes of a doubtful or ephemeral nature. Thus a quotation on the Stock Exchange is a prime necessity to any new enterprise, while its absence is a certain proof that some condition necessary to a chance of success is absent.

Meantime, enterprises arose and multiplied throughout this and other countries. Municipal improvements, railways, telegraphs, shipping, and trading companies sprang into existence, and sought the aid of the investing

public, until classes of business with their separate operators became necessary, and many distinct markets were formed on the Exchange.

The management of the House became more and more a matter of importance under the conditions above indicated. Not only the relations between elected members, but also the interests of the outside public, were carefully considered. The committee have also made special enactments, such as forbidding members to advertise, to deal with bank and other clerks, and have set their faces sternly against any attempt to entrap into speculation the ignorant or the foolish. How far they have succeeded is a matter of opinion, but the high tone of the members may be gathered when we say that exclusion for dishonest or dishonourable conduct is scarcely known. These self-made laws and regulations are not only in full force, but command the respect and approval of all dealers and investors both outside as well as inside the Exchange.

As in all societies of this class, much has been due to individual ability and character, and many names stand out conspicuously; and the descendants of these gentlemen, whether lineal or business, for the most part still occupy a status in the institution, whilst others of equal reputation now form the governing body or are eminent members.

We give a list of the principal gentlemen and Firms who are members; at the same time acknowledging the trustworthiness of the whole body, the majority of whom, however, our space will not permit us to name.

Managers.

LAWRENCE J. BAKER, M.P.
ROBERT H. BRISTOWE.
LIONEL L. COHEN, M.P.
ANDREW K. HICHENS.
EDWIN H. LAWRENCE.
JAMES H. RENTON.
ALEXANDER J. SCRUTTON.
SAMUEL G. SHEPPARD.
WILLIAM TROTTER.

Secretary—W. F. PEROWNE.

COMMITTEE FOR GENERAL PURPOSES.

Chairman—JAMES N. SCOTT. *Deputy-Chairman*—H. ROKEBY PRICE.

James S. Adams.
William J. Carr.
Edward Clark.
John H. Daniell.
Thos. Fenn.
Neil M. Forbes.
Laurence Harrison.
Thos. P. Hilder.
John Marnham.
Fredk. H. Milbank.
John Norbury.
Hammond Paine.
Leeds Paine.
John W. Parker.
John F. H. Read.
Septimus R. Scott.
Edward Smith.
Edmund Smith.
Charles A. Streeter.
Henry E. Tatham.
David L. Thomson.
Richard Thorp.
Samuel Underhill.
Arthur Wagg.
George Wedd.
Henry A. Wedd.

Secretary—FRANCIS LEVIEN. *Secretary of Share and Loan Department*—HENRY C. BURDETT.
Official Assignee—ERNEST C. GRANT. *Deputy-Official Assignee*—DAVID J. STUART.
Manager of the Settlement Department—WILLIAM B. BELLARS.

Leading Members.

Akroyd, John
Anderson, Arthur, & Co.
Baines & Co.
Baker, Arthur Henry
Baker & Sturdy.
Banbury, Frederick, & Sons.
Barker, Ernest, & Co.
Barnett, W. H. L., & Co.
Barron Bros.
Barry & Co.
Biedermann, A., & Co.
Bone, J. G., & Son.
Bonhwick, Wark, & Co.
Bragg, Stockdale, Hall, & Co.
Bristowe Bros.
Bristowe, W., & Co.
Brunton, Bourke, & Co.
Burnand, G., & Co.
Capel, James, & Co.
Carden, Sir R. W., & Co.
Carr Bros. & Smith.
Carr, W. J. & Sons.
Castello, Daniel, & Sons.
Cavell, Strachan, & Lardello.
Cawston, G., & Co.
Cawston, Samuel, & Co.
Cazenove & Akroyds.
Cazenove, F., & Co.
Charlesworth Bros., & Co.
Chinnery Bros.
Clarke Bros.
Clayton & Aston.
Coates, Son, & Co.
Cohen, Louis, & Sons.
Cook, Malcolm, & Lemon.
Cooper, Sidney, & Co.
Coulson & Ward.
Crews, Lichtenstadt, Roth & Co.
Daniell, Hurst, & Fairclough.
Davies, Jefferson, & Co.
Davison & Jones.
Dawes & Puckle.
Derenberg & Co.
De Zoete & Gorton.
Douglas, J. M., & Co.
Ellis & Co.
Ellissen, G., & Co.
Escombe, R., & Co.
Eykyn Bros.
Eyton & Eyton.
Fenn & Crosthwaite
Fenner & Russell.
Ferguson & Clark.
Fielding & Son.
Foote & Adams.
Forbes & Dickinson.

Foster & Braithwaite.
Fowler & Hodgson.
Francis, Robert, & Son.
Fuller Bros.
Furlonger & Son.
Galloway & Pearson.
Gibbs & Tatham.
Giles & Cresswell.
Giles & Overbury.
Giles & Son.
Gordon, Panmure, Hill, & Co.
Gowan & Marx.
Gramshaw & Cottrell.
Greenwell, W., & Co.
Greenwood & Co.
Grieveson, Grant, & Co.
Gundry, Mills, & Co.
Haggard, Hale, & Pixley.
Hales & Sons.
Hammond, C., & Sons.
Handcock & Webb.
Hardy Bros.
Harris & Co.
Harris, Goldsmith, & Co.
Hartridge, W. R., & Co.
Hawkings, C. F., & Sons.
Hecht & Behrens.
Hedderwick & Schultz.
Helbert & Wagg.
Helps, Albert, & Son.
Hensley & Ashton.
Herapath, Spencer, & Co.
Herbert, G. S., & Sons.
Herbert Bros.
Heseltine, Powell, & Co.
Hitchens, Harrison, & Co.
Hides & Levy.
Hilder & Moens.
Hill, Fawcett, & Hill.
Hill, John, & Sons.
Hilton & Gibbes.
Holland, Balfour, & Hamilton.
Holtebone Bros., & French.
Holmes Bros.
Hope, Dodgson, & Co.
Hughes & Prevor.
Hunt, Cox, & Co.
Hutchinson, J., & Son.
Ingall, W. T. F. M., & Co.
Ingram & Flemming.
Jacks, Hodgson, & Jacks.
Jacobson & Sons.
Jourdan & Pawle.
Judd & Chapman.
Keen, Sturgis, & Co.
Kennedy & Robertson.
Kennedy, Sydney, & Co.
Kitchen, Albert G., & Co.
Kitchen, T. M., & Co.
Lack & Allcard.
Laing & Fletcher.
Landau & Alexander.
Lane Bros.
Langdon & Willis.
Laurence, Sons, & Gardner.
Laurie, Milbank, & Co.
Lawford, G., & Co.
Leon Bros.
Lindow, King, & Co.
Linton, Clarke, & Co.
Littlejohn, Alexander, & Co.
Lloyd & Ward.
Macnicoll & Rodgers.
McAnally & Inglis.
Marten & Christopherson.
Martin & Hall.
Marzetti & Co.
Medley, A. O., & Son.
Medley, G. W., & Co.
Messel, L., & Co.
Midlane & Co.
Mieville & Co.
Miles Bros.
Mocatta, A., & Co.
Montgomery & Vans-Agnew.
Moore, W. B., & Sons.
Maurice, J. C., & C. W.
Morris & Puckle.
Morris, Son, & Hill.
Morris & Spurling.
Morris, William, & Sons.
Mortimer, Roger, & Co.
Mullens, Marshall, & Co.
Murton & Smallpiece.
Newman & Dorling.
Nickalls Bros.
Nickalls, T., & Co.
Nickisson, Evans, & Co.
Oates & Cockburn.
Paine, Hammond, jr., & Co.
Paine, Marshall, & Co.
Palmer & Baddeley.
Palmer Bros.
Parker & Richardson.
Partridge & Greenfield.
Pawle, H., & Co.
Pawle, J. D., & Angle.
Pember & Boyde.
Peppercorne & Mant.
Phillips, F. S.
Phillips, Lewis, & Son.
Pidgeon, Stebbing, & Taylor.
Pim, Vaughan, & Co.
Pratt, Clapham, & Reynell.
Price & Pott.
Price Bros., & Co.
Prior & Williams.
Pritchard, John, Mostyn, & Co.
Prust, John, & Co.
Quihampton, Thomas.
Ramsey Bros.
Ransford & Schiff.
Raphael, R , & Sons.
Reid, J. & J.
Renton, Bros., & Co.
Reynolds, W., & G.
Ricardo, A., & W.
Ricardo & Co.
Ricardo & Woodroffe.
Ricardo, Poston, & Co.
Richardson & Solomon.
Robbins Bros.
Russell Bros.
St. Alphonse & Halls.
Samuel, Lewis, H., & Co.
Samuelson, L., & Co.
Sandeman, Clark, & Co,
Satterthwaite & Co.
Schiff, A. G., & Co.
Schofield Bros.
Schweder, Paul E., & Co.
Scott, Corthorn, & Scotts.
Scott, J. N., Son, & Fuller.
Scott, S. R., Stratten, & Co.
Scrimgeour, J., & A.
Scrutton & Son.
Sebag, J., & Co.
Sewell, Ewings, & Co.
Seymour, Pierce, & Co.
Shanks, J. H., & Co.
Shepherd, J., & Co.
Sheppards, Pelly, & Allcard.
Shirreff, J. A., & E. C.
Shorter, Clements, & Shorter.
Silverston, J., & Co.
Smith & Ruston.
Smith, E. B.
Smith, Early Bros.
Smith, F. M., & A.
Smith, Le Blanc, & Erskine.
Smithers & Williams.
Sparkes & Clark.
Sperlin & Elin.
Spurling & Skinner.
Stanley, C., & Sons.
Startin Bros.
Stearns, E., & A.
Steer, Lawford, & Co.
Stewart, Tiley, & Co.
Streeten, C. A., & Day.
Sutton & Co.
Taylor, J., & Co.
Tatham, Robinson, & Henry
Thompson, J. S., & Co.
Thomson & Carlisle.
Thornhill Bros.
Tomkinson & Price.
Trew, J. P., & Co.
Tunks, C. G., & Co.
Underhill & Le Mare.
Underwood & Newman.
Vaughan, Talbot, & Co.
Vertue & Co.
Vigne, H., & Sons.
Vivian, Gray, & Co.
Wadeson & Rose.
Waithman, Massey, & Co.
Walker, J. S., & H. R.
Ward & Nye.
Webb, W. L., & Co.
Wedd, Jefferson, & Co.
Wedd & Lobb.
Whiteheads & Coles.
Whittington, C. J., & Co.
Wildy & Co.
Wilkinson, W. A., & N., & Co.
Wilkinson, & Swift.
Wilson, Alexander, & Sons.
Wilson & Ellis.
Wilson, Brown, & Montague.
Wise & Burnell.
Wood & Sons.
Woolley, Lowndes, & Co.
Woolston & Beeton.

ARTS AND INDUSTRIES

OF

GREAT BRITAIN.

Mr. Dan Rylands, Barnsley.

UNDER the auspicious reign of Her Gracious Majesty, of whose Jubilee these pages are a kind of *souvenir*, not only have new industries sprung up beyond enumeration, but new developments of established trades have also been made by men of clear foresight and unwearied energy, in a manner that has quite outstripped and superseded the older firms. In taking adequate note of this progress, we have found it necessary to include in this volume, as representative of their particular line of industry, firms which, in the matter of age, have not celebrated their majority, and yet which—for the character of their manufactures, for their thorough enterprise, as well as for their eminent success—stand head and shoulders above their competitors. Such is the Firm to which this article is appropriated. Queen Victoria had occupied the throne of England for full thirty years when the first portion of the works illustrated on next page was erected; but long before the arrival of Her Majesty's Jubilee the manufactures of the Firm had found their way into every quarter of the globe. It is this kind of success of new developments of industry that has materially contributed to the prosperity and happiness of the Victorian era; that has studded over England busy hives of industry similar to Hope Glass Works; that has not only amply rewarded the enterprise of their founders but has furnished the means of honest livelihood to thousands of British workmen; that has been inseparably connected with the well-being of innumerable households, and maintained for England the position which she has so long enjoyed as the market of the world.

Mr. Dan Rylands' manufactures are particularly well adapted for the foreign market; yet they have been none the less devised to meet the demands at home as well. The requirements of tropical climates have not only been sympathetically met at Mr. Rylands' Works, but he has also been in touch with the enormous demand for mineral waters in our own country; and whether at home or abroad, mineral water manufacturers have received from Mr. Rylands the utmost consideration for their requirements that skill and experience could furnish, to enable them to meet the vast change that has been gradually taking place in the drinks of the world. To the mutual efforts of Mr. Rylands and his customers the public may, to a great extent, attribute the almost endless variety of aerated drinks now so attractively placed before them at popular prices. It has been this anticipation of the requirements of the country that has built up Mr. Rylands' extensive business, and created that demand for his specialties which has made his name the leading one connected with this industry.

About the year, 1867, Mr. Ben Rylands, the father of the present proprietor, commenced the Hope Glass Works, which are situate about two miles from Barnsley in Yorkshire, and by the use of good materials, careful attention to details, and much practical skill, soon made for himself a good name as a glass bottle manufacturer, and thus laid the firm foundation upon which such an extensive business has since been built. In

the year, 1873, Mr. Rylands turned his attention to a new globe-stoppered soda-water bottle, and with his characteristic determination all difficulties were mastered, and the now well-known glass globe-stoppered bottle soon became a decided success. The character of the bottle required the utmost precision in manufacture as well as special strength of glass, but these two requirements were so carefully attended to that Hope Glass Works had soon to be enlarged and exclusively devoted to the manufacture of these bottles, in order to meet the enormous demand which was thus created both in home and foreign markets. Many unique advantages distinguished the bottle from anything then in use; the fact of its being automatically, as well as hermetically, sealed by an ordinary glass marble seemed at once the perfection of simplicity; and although there were other internal stoppers then competing against this glass stopper the others were all more or less objectionable, on the ground that the materials of which they were wholly or partly composed acted deleteriously upon the contents. Owing to the purity and cleanliness of the glass marble, as against its objectionable competitors, and to the effective simplicity with which the marble automatically sealed the bottle from within, as against the wiring and unwiring of the ordinary corks, and the still greater objections of other external stoppers, Mr. Rylands was soon

HOPE GLASS WORKS, BARNSLEY.

able to revolutionise the trade with his careful manufacture of the glass globe-stoppered bottles, which have now completed superseded all the other crude and complicated stoppers. Probably it was nothing less than a full anticipation of this result that induced Mr. Rylands not only to devote all his energies to overcome the difficulties which the bottle first presented, but also to completely adapt his works to, and risk his capital upon this one bottle, in a spirit of enterprise that never fails to reward its possessor.

In the year 1877, the inventor of the bottle (Mr. Codd) was admitted into partnership with Mr. Rylands, being then in a position to take up a one-fifth share in the business, whilst the remaining four-fifths of the share capital remained in the hands of Mr. Rylands, with whom still rested the responsible management. The business was carried on under these conditions with increasing prosperity until, in 1881, Mr. Rylands died, at a time when his well-directed efforts were just beginning to meet with the reward they so well deserved. Mr. Dan Rylands (the present proprietor) had always been intimately connected with the management of Hope Glass Works so that he was well prepared to succeed his father in the control of the business; but it was only at the expense of a heavy premium that Mr. Dan Rylands became joint partner with Mr. Codd. Three

years later, in 1884, however, this association was ended by mutual consent; and Mr. Dan Rylands, paying out his partner, became sole and absolute owner of all the goodwill, patent rights, and business of the Firm, and has ever since carried on the concern on his own responsibility and in his own name.

In the hands of the present proprietor, the business kept up more than its former rate of progress. Inheriting the spirited perseverance of the late founder of the business, Mr. Dan Rylands has continued to extend and adapt the Works to meet the growing demands upon his resources, so that now the Works include two of the largest continuous and regenerative gas glass-melting furnaces in Great Britain, and six smaller ordinary intermittent or day furnaces, all conveniently arranged and fitted for the perfect and rapid production of glass. Mr. Rylands has given his special attention to the development of the regenerative gas-furnace system for melting glass, and is the owner of several patents connected therewith. The essential strength of glass necessary for globe-stoppered bottles has also been his careful study, so that at the present time his bottles are world-renowned for this particular quality, along with general excellence of manufacture. Mr. Rylands has registered the figure "4," which has for many years been the distinguishing mark stamped upon the bottles sent from these Works; so that the presence of that figure upon any of this class of bottles will be sufficient indication that the bottles so stamped are of Mr. Rylands' special manufacture. It has been a principle of the proprietor to render his Works self-contained as much as possible; so that not only is the ponderous machinery of the Works kept in repair by his own mechanics, but many of the mechanical appliances in use have been invented and constructed in Mr. Rylands' own engineering department; and in every respect there is as little reliance as possible upon the outside world for anything that can conveniently be manipulated within the small colony of which a bird's-eye view is given on the preceding page.

But Mr. Rylands is also an inventor, who, probably, in his own line of glass bottles, possesses more patents than any other person. Much of his skill has been expended on the development of the class of bottles for which his Works are specially distinguished—namely, globe-stoppered bottles, and we give an illustration of his most successful achievement in this direction.

POSITION FOR OPENING.

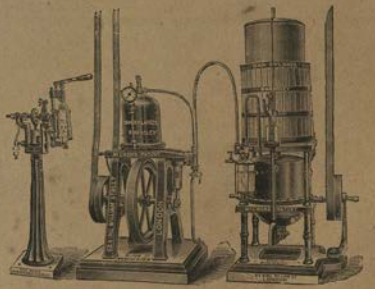
The engraving shows one of Rylands' Patent Crystal Valve Self-opener Aerated Water-bottles. It is stoppered by an internal glass globe, held by pressure against the india-rubber seating in the mouth, similar to the ordinary globe-stoppered bottles; but, instead of forcing the stopper when opening upon the whole body of the gas within the bottle, provision is made for the release of the pressure through a small valve in the bottle's neck. This valve consists of a small glass stem, which, in some cases, is made to act by a slight screw, and in others by the pressure of the thumb. The engraving shows the latter style of valve, and the manner in which the valve is operated upon; a slight pressure of the thumb is sufficient to break the gas seal, and allow the stopper to fall from its seat, without either the danger of bursting or the inconvenience of splashing, so frequently attendant upon the opening of globe-stoppered bottles by the ordinary method of forcing the stopper down with a rigid opener. This valve-bottle also possesses the advantage of dispensing entirely with the necessity for openers of any kind. Besides a number of other interesting inventions in bottles, some stoppered internally, some externally, according to the varied requirements of his customers, Mr. Rylands has also patented a special process for colouring the mouths of bottles with a colour distinct from the remaining portions of the bottle. As the same colour is not supplied to more than one person in a district, an additional means is thus afforded the mineral-water manufacturer for detecting his bottles even at a great distance; and, at the same time, this special method of colouring the mouth of the bottle considerably increases its attractiveness.

Passing to another department of Mr. Rylands' Works, we find the largest mineral water box factory in the world, erected to meet the demands of those customers who require their bottles supplied in boxes partitioned ready for use. Here an army of workers, with the aid of the most approved and modern wood-cutting and other machinery, and with a rapidity that is simply marvellous, is constantly found transforming huge pieces of timber into brand new partitioned boxes, varnished and painted fit for use in any high-class hotel in the country. Here again Mr. Rylands is ahead of his competitors with a special make of box, of which we give an

illustration. As its name indicates, the distinguishing feature of Rylands' Patent Wire-Bound Box consists in the substitution of wire binding for the ordinary hoop-iron. The objections to hoop-iron are that it deteriorates from exposure to the action of wet and rust, and catches against everything it comes in contact with. All these objections are at once overcome in Mr. Rylands' patent box by the wire being placed in a groove. The wire also passes all the way round the box ends as shown, and really increases the strength of the box above that of ordinary hooped boxes, while at the same time it reduces the weight and improves the appearance. The boxes can also be bound with patent twisted wire, which allows at proper distances a nail to pass between the strands of the wire down into the centre of the box sides; by the expansion of the wood into the recesses of this twisted wire still further strength is obtained. By the purchase of the patent rights and business of the European Strap Company, Mr. Rylands has acquired the sole right of spinning this Patent Twisted Wire, which is an economical substitute for hoop-iron in the binding of ordinary boxes or packages of any kind.

PATENT WIRE-BOUND BOX.

In the same year in which Mr. Rylands paid out his late partner, and took upon himself the whole of the responsibilities of his glass bottle and box manufacturing business, he also purchased the patent rights, business, and works of the firm of J. McEwen & Co., mineral water machinery engineers. By this bold and enterprising act Mr. Rylands acquired the sole right of manufacturing and vending the most popular mineral water machinery in the country. McEwen's Patent Machinery had then an established reputation; and since then it has obtained the Gold Medal at the only two International Exhibitions at which it has been shown. This aerated water machinery is acknowledged to save 30 per cent. in materials and 50 per cent. in driving power as compared with other systems of mineral water manufacture; and amongst its minor qualities is the fact



RAPID PARAGON FILLER AND AERATED WATER MACHINE.

that it is the most compact in the market. The engraving clearly illustrates this latter advantage. The two portions to which the straps or belts are attached are the mineral water machine proper. The small machine on the left-hand side is a "Rapid Paragon" Filler, for filling bottles with aerated liquids. One of the principal and novel features of the aerated water machine is the Anti-Atmospheric Generator, which is thus described in a scientific report of the machine, published in connection with the Edinburgh International Exhibition, at which it was shown:—"This useful machine consists of a substantial cast-iron frame, supporting the generator and gasometer as well as a tub for mixing the whiting with water prior to use. The whiting being placed in the mixer along with a sufficiency of water, is ground to a cream by a revolving fan, and by a simple contrivance is made to enter the generator from below, the entrance of air being impossible. An automatic acid tap, using an ingenious valve arrangement of glass ball and lead, regulates the supply of vitriol, while the ascent of the

gasometer suffices to cut off the supply entirely when sufficient gas has been generated. The final exhaustion of the charge is indicated by the descent of the gasometer and the ringing of an electric bell. A new charge can be introduced and the old removed within five minutes, while a considerable saving of acid is effected. The condensers exhibited are all self-saturating, *i.e.*, have no agitators, and produce water of excellent quality. The impregnation is effected by the contact of carbonic acid gas with water in a fine state of division. The water and gas enter the cylinder at the top, and the former in passing to the bottom is distributed by means of shell tin and perforated plates, so that before it becomes quiescent at the foot it has become throughly saturated with gas." Of the "Rapid Paragon" Filler little need be said beyond the fact that 2,500 of these machines have been sold during the few years they have been before the trade. This also is an invention of Mr. McEwen's, who we may state *en passant* is the consulting engineer in Mr. Rylands' mineral water machinery department. The popularity of this filler undoubtedly consists in its speed and simplicity, a boy or girl being able to fill with ease from sixty dozen to eighty dozen bottles of aerated waters per hour. It is the only machine of its kind that has obtained two Gold Medals, a distinction of which it is well worthy, as evidenced by the unprecedented rapidity with which it has sold. In mentioning Gold Medals, we may add that similar distinctions have been carned by Mr. Rylands' other specialties when he has cared to put in an appearance at International Exhibitions.

Mr. Rylands undoubtedly occupies the unique position of being the exclusive manufacturer at the present time of the most novel bottles and celebrated boxes and machinery for the mineral water trade, and, in addition, he is also able to supply every other trade requisite, such as bottle-washing machines, labels, essences, and other accessories. He issues a large illustratgd catalogue of mineral water requisites, and any one contemplating entering the mineral water trade cannot afford to neglect a perusal of that catalogue.

Messrs. Ransomes, Sims, & Jefferies, Limited, Ipswich and London.

THE Orwell Works, which take their name from the river on which Ipswich, the most enterprising town in East Anglia, is situated, constitute one of the most extensive and historically-interesting establishments devoted to practical engineering in the United Kingdom. Founded close upon one hundred years ago, in 1789, by Robert Ransome, these Works have extended their limits until they now cover upwards of twelve closely-built acres, giving employment to about 1,400 men and boys. Distant only ten miles from the sea, and with a direct route to the Continent, they have a dock frontage of about 1,000 ft., and the Great Eastern Railway Company's line runs along this quay direct into the Works, so that goods can be despatched from the warehouse by rail or steamer to all parts of the world.

The Firm of Ransomes, Sims, & Jefferies, Limited, is one of the most eminent, not only in Great Britain, but in the world, and is principally engaged in the manufacture of portable and fixed steam-engines, steam-thrashing machines, corn-mills, ploughs, and field implements. The manufacture of portable engines was commenced by Messrs. Ransomes in the year 1841, and at the Royal Agricultural Society's meeting, held at Liverpool in that year, they exhibited a portable engine driving a thrashing-machine, and in their report of the show, the judges made the following remarks:—

"To Messrs. Ransomes, of Ipswich, the Society is indebted for what may be termed the greatest novelty of the meeting, viz., the exhibition of a portable steam-engine for the purpose of thrashing corn. The advantages of steam-power for working fixed thrashing-mills have long been acknowledged, but we believe this is the first attempt to render it portable, so that it may be transported from one farm to another as easily and as expeditiously as the present machines with horse-power."

At the Bristol meeting of the same Society, in 1842, Messrs. Ransomes brought out this engine in a new form, the engine, boiler, and thrashing-machine being placed on a four-wheel carriage. This carriage was arranged to be *self-moving*, and it is recorded that this engine travelled along the road at the rate of from four to six miles an hour, and was guided and manœuvred so as to fix it in any particular spot with much ease.

Having from this early date given the manufacture of portable engines continuous attention, and adopting every improvement that so long a practice and experience suggested, those now made by this Firm stand in the foremost rank. Being very simple in design, they are characterised by the strength of all their parts, and ample wearing surfaces, whilst the steam is so employed as to give the greatest possible efficiency. One of these engines is shown in Fig. 1. Fig. 2 is an agricultural locomotive engine adapted for drawing the steam-thrashing machine with it from farm to farm, thus making it eminently suitable for agricultural purposes. One of the most important inventions in connexion with the portable engine, and its application to agriculture, is Messrs. Ransomes' patent arrangement for using straw as fuel, shown in Fig. 3. By means of this invention every description of vegetable matter can be used as fuel, and steam-power is, therefore, made

available in many countries which have hitherto been debarred from its advantages, owing to the scarcity and consequent expense of coal and wood.

The increasing demand for stationary engines, varying in size from 3 to 100 horse-power nominal and upwards, has induced Messrs. Ransomes to pay particular attention to this branch, and these engines are turned out with all the latest appliances for using the steam economically and with every consideration as to

FIG. 1.—PORTABLE STEAM-ENGINE.

FIG. 2.—AGRICULTURAL LOCOMOTIVE.

FIG. 3.—PATENT STRAW-BURNING ENGINE.

strength and simplicity of design. They are made either single or coupled in pairs, with or without condensers, and also on the compound system, and are suited for driving all kinds of machinery, such as electric lighting, winding and hoisting, sawing machinery, pumping, &c. Some of these engines have a special wrought-iron frame, which can be taken to pieces so as to reduce the weight of the packages for facility of transport in

FIG. 4.—LONG-STROKE FIXED ENGINE.

FIG. 5.—LANCASHIRE BOILER.

FIG. 6.—UNDERTYPE ENGINE.

rough countries. Fig. 4 shows the general design of the larger engines, and Fig. 6 of the "Undertype" engines, made high pressure or compound as desired. The large boilers with which the stationary engines are supplied, as well as the portable boilers, are made at the Works, the shops for this purpose being provided with hydraulic rivetting, and flangeing machinery, and planing and drilling machines of the latest construction. Fig. 5 represents a Lancashire boiler, fitted with cross circulating tubes, for economising fuel.

FIG 7.—STEAM THRASHING MACHINE.

FIG. 8.—STRAW BRUISING THRASHER.

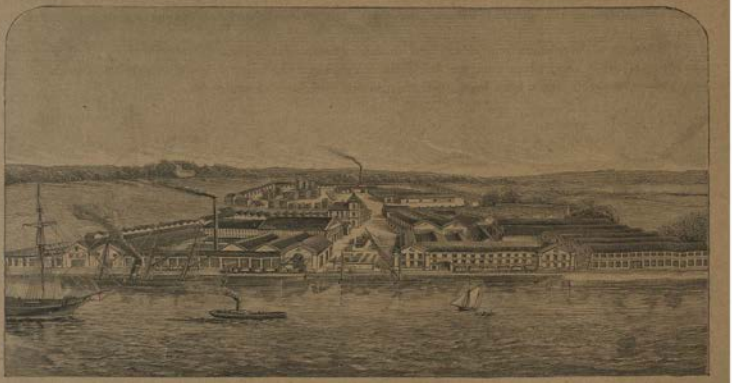
FIG. 9.—PATENT TEA SORTER.

From the earliest introduction of the electric light, Messrs. Ransomes' motors have been in request for driving dynamos. Their engines have been used at the installations on the Thames Embankment, at South Kensington Museum, and numerous other places in England and abroad; the patent automatic governor expansion gear with which the engines for this purpose are fitted, has given everywhere the most satisfactory results. It ensures so great a regularity in speed that, during a series of observations extending over twelve

days, with an average speed of 14236 revolutions per minute, the variation was never found to exceed 1'12 revolutions.

In addition to the engines we have illustrated, Messrs. Ransomes are largely engaged in the manufacture of winding and hoisting machinery. These have been supplied to Spain, Mexico, the Cape, &c. Steam-pumping machinery is another branch we find included, and corn-mills, in a small portable form, for the wants of the agriculturist; whilst they supply complete plant for large fixed mills, with the most improved wheat-cleaning and flour-dressing machinery.

As already pointed out, the credit of having led the van in connexion with Steam Thrashing Machinery belongs to Messrs. Ransomes. Since the time that they showed the first machine of this kind in 1842, Messrs. Ransomes have given undivided and continuous attention to this department. The machine of the present day embodies not only a thrashing machine but also a complete dressing and winnowing apparatus and grain-sorting machine, all combined in one. From the simple thrashers of but a few years ago with only one or two working parts, to the "combined" machines of the present day, illustrated in Fig. 7, there is a wide



THE ORWELL WORKS, IPSWICH.

difference, and, one would think, after seeing the sheaves put into the drum at the top of the machine and the corn coming out into sacks completely dressed for market, that no further improvement could possibly be effected.

To this Firm is due also the adaptation of steam-thrashing machines to the special requirements of hot countries, where, from time immemorial, the process of thrashing has been performed by treading out the grain either by horses or oxen. This ancient and slow process left the straw in a soft and macerated condition fit for feeding cattle, but very dirty. In an ordinary thrashing machine the straw is delivered unbroken, and, although straw is sometimes used for feeding purposes, after having been cut up by a chaff-cutter, this process is quite useless in hot countries such as India, Egypt, &c., where the straw is much harder and of a more woody nature, as the sharp edges of the cut straw injures the mouths of the animals. To get over this difficulty, in 1865 the Firm took out a patent for an apparatus for "chopping and bruising the straw," as shown in Fig. 8. The straw is passed through rapidly-revolving rollers furnished with knives and projections, which, while thoroughly bruising the straw, leave it much cleaner than the old method.

In Fig. 9 is illustrated Ansell's Patent Tea Sorting and Winnowing Machine, of which Messrs. Ransomes, Sims, & Jefferies are the sole manufacturers. This machine, which was awarded a Gold Medal at the Calcutta Exhibition in 1884, is the most complete and efficient apparatus which has yet been introduced for the separation and winnowing of tea.

We now come to another department in which this Firm has long been familiarly associated, Plough-making is as much a science as engine-building, exactness of construction on scientific principles being necessary to ensure success. The number of ploughs of different kinds made by Messrs. Ransomes, Sims, & Jefferies, is simply enormous, ranging from the small and cheap wood ploughs of a primitive type—see Fig. 10—suitable for India and other countries where agriculture has not yet made rapid strides, to the Prize Plough shown in Fig. 11, made entirely of iron and steel, with long curved breasts for the highest and most perfect style of ploughing, as practised at the ploughing competitions in England and her colonies, and the strong and powerful implements for turning two, three, or four furrows at once, some of them fitted not only with a seat for the ploughman to ride but with an improved patent lifting apparatus. Although double and multiple ploughs were introduced many years since, they did not come into general use on account of their weight and difficulty of handling. By the introduction of Messrs. Ransomes' patent double-wheel lifting apparatus this difficulty has been entirely surmounted, and it has been widely adopted by all the leading plough-makers in Europe. Messrs. Ransomes also manufacture in large numbers the so-called "Chilled Plough," the breasts and shares of which are made of chilled cast-iron. It turns a very wide and deep furrow, completely pulverising the soil and burying the weeds, and is excellent for preparing a good seed-bed at one operation.

Horse-rakes, haymakers, and other field implements are also made in large numbers. Of the "Star" rake brought out in 1869, which took the first prize of the Royal Agricultural Society, in competition with all the large makers, probably more have been made than of any other similar implement.

FIG. 10.—PRIMITIVE PLOUGH.

FIG. 11.—NEWCASTLE PRIZE PLOUGH.

FIG. 12.—THREE-FURROW PLOUGH.

Whilst speaking of the plough, reference must be made to the Patent Chilled Ploughshare and its prominent connexion with the history of the Firm, as it will be seen that this large concern, whose manufactures in all branches are known all over the wide world, came first into notoriety through its introduction. It was in the year 1785 that Robert Ransome, then of Norwich, took out his first patent for a method of tempering cast-iron ploughshares. In 1789 Mr. Ransome removed to Ipswich, and, still continuing to devote attention to this subject, he discovered and patented in 1803 the process of manufacturing cast-iron ploughshares with the underneath side chilled or crystallised, whilst the upper part remains soft. When these shares are at work in the ground the upper surface wears away, whilst the underneath part, being harder than steel, constantly maintains a sharp cutting edge. These chilled shares being inexpensive, entirely superseded the costly wrought-iron shares previously in use; and, although cast-iron had been already used for making ploughshares, they were most unsatisfactory, as they had a constant tendency to wear blunt and thick at the edge, increasing the draught of the plough. It will thus be seen that this invention of the chilled share was, perhaps, the greatest invention that has ever been made in connexion with ploughs, and is now used by makers in every country, and hundreds of thousands are annually produced. The illustration, Fig. 13, represents a patent chilled cast-iron ploughshare, broken to show the hard, steely chilled surface.

FIG. 13.—PATENT CHILLED PLOUGHSHARE.

Messrs. Ransomes are the only Firm who have received Two Gold Medals from the Royal Agricultural Society of England, and they also hold twenty Silver Medals from the same Society. In addition to these Messrs. Ransomes have received the Cross of the Legion of Honour from the French Government, the Order of the Medjidieh from the Sultan of Turkey, and the Order of the Commander of Christ of Portugal, with numerous medals and awards, making a total of about £4,000 in money prizes, 110 Gold Medals, 250 Silver Medals, 90 Bronze Medals, and 275 First Prizes, with hundreds of Second Prizes, High Commendations, Certificates of Merit, &c.

Messrs. Ransomes, Sims, & Jefferies, Limited, have received at all the great International Exhibitions the highest possible awards, amongst which may be noted the following :—

London, 1851	Three Council Medals.	Vienna, 1873	Diploma of Honour.
London, 1862	Two Prize Medals for excellent work, practical success.	Cape Town, 1877... ...	Diploma of Honour and Gold Medal.
		Paris, 1878	Three Gold Medals.
Paris, 1867... ...	Grand Prix and Gold Medal.	Melbourne, 1881	The Highest Awards.
Berar, India, 1868 ...	The First Prize.	Odessa, 1884	Diploma of Honour.
Santiago, Chili, 1869	Grand Prize, two Gold Medals, and 1,300 dollars.	Amsterdam, 1884 ...	Prize of Honour, value £40, and six Gold Medals.
Moscow, 1872	Great Gold Medal.	Inventions, London, 1885..	Two Gold Medals.
Lima, Peru, 1872	Gold Medal.		

We must now conclude our notice of the Orwell Works, which it will be seen has, for the last century, been actively engaged in the production of agricultural machinery, and whose manufactures are known in every part of the world. In 1884 this business was converted into a private limited liability company, of which the managing directors are Mr. J. E. Ransome (a grandson of the founder), Mr. J. R. Jefferies, and Mr. P. E. Ripley.

Messrs. Sutton & Sons, Reading.

AGRICULTURE and Horticulture are second to no industry in their economic value to mankind. The one helps to supply us with the necessary food, and the other ministers to the finer sensibilities of human nature. This latter fact is emphasised by Lord Bacon, who observes that a garden "is the purest of human pleasures; it is the greatest refreshment to the spirits of man; without which buildings and palaces are but gross handiwork." Few of us but have realised this, and have felt that our mental and physical health depends, to some extent at least, upon our outside surroundings. Fresh air, exercise, recreation, are all to be obtained in the garden; and whatever the season of the year,—whether spring with its fresh verdure, summer with its various shades and hues, or autumn with its russet tinges, —there is always something in it to afford pleasure to the eye, gratify the senses, and exercise a soothing influence upon the mind. A garden has, indeed, been happily compared to a beautiful book written by the finger of God, every leaf and flower being a letter; and one at least of our great poets, Pope, professed to be prouder of his garden than of any other of his works.

During the period covered by Her Majesty's reign, a marked advance has been witnessed in horticulture as well as in agriculture, and, while the former has developed into an art, the latter is now carried on in accordance with scientific principles. Both have, in this respect, kept pace with the progressive movement of the last fifty years. From among the agencies that have been most powerfully instrumental in furthering the development of horticulture no less than of agriculture within the period in question, stands forth prominently the Royal Seed Establishment of Messrs. Sutton & Sons, at Reading. This place of business is the largest of its kind in the world, and, although it was established by the father of the present senior partner, in 1806, for the supply of agricultural seeds only, yet the Firm may be said to have taken a new departure by adding the horticultural and grass seed trades to the older business, almost exactly at the commencement of Her Majesty's reign; for it was in 1832 that the present senior partner, Mr. Martin Hope Sutton, was taken into partnership, by his father, and his jubilee as a member of the firm was celebrated in 1882, the year when the Royal Agricultural Society visited Reading, and when the Firm was honoured by a special visit of His Royal Highness the Prince of Wales. On this occasion, the *Times* had a large-type article in its issue of July 13, containing the following sentences:—

"His Royal Highness the Prince of Wales made a tour of the show, and on leaving visited the seed-trial grounds of Messrs. Sutton & Sons. This Firm possess the largest retail seed business in the world, exceeding even that of Messrs. Vick, at Rochester, in the United States. The business premises, presenting a handsome front in the Market Place, are models of arrangement, construction, and fitting, and cover nearly six acres. To give some idea of the magnitude as well as elaborate character of the commercial operations in farm, vegetable, and flower-garden seeds for all countries on the globe, it may be mentioned that

60,000 ledger accounts are kept, the number of letters received per day in the busy season approaches 2,000, about 700 parcels of seed are despatched daily; and, in one room alone, actually 2,000,000 packets of vegetable seeds can be seen at one time labelled in readiness for supplying orders."

This great business is still in the hands of the founder, his brother, and their sons. The present partners are Mr. Martin Hope Sutton, Mr. Alfred Sutton, Mr. Martin John Sutton, Mr. Herbert Sutton, Mr. Arthur W. Sutton, and Mr. Leonard G. Sutton. There can be no doubt that the great success of Messrs. Sutton's business, and its acknowledged position as the head of the seed trade, is largely due to the fact that the management has always been kept in the hands of the Firm, and that each of the hundreds of thousands of letters annually received has the personal attention of one or another of the partners themselves. The numerous buildings grouped together in the following illustration will give some idea of the magnificent scale on which the interior arrangements of the various departments of the business have been planned.

The Royal Seed Establishment occupies a central position in the historic old town of Reading, and has frontages to three thoroughfares, viz., to the Market Place, the Railway, and Abbey Street. Soon after entering, the visitor gains some idea of the extent of the premises, and of the magnitude of the business carried on. Indeed, one of the first things he finds is a private Post-office, the resources of which are equal to despatching 10,000 letters to all parts of the world within a few hours! Not only so, however; as many as 18,000 packets of seeds have actually been posted here in one day to their various destinations!

The Ledger Office is a large and lofty apartment, containing three rows of desks extending the whole length of the room. Some notion of the care that has to be taken in keeping the 70,000 accounts, so as to avoid mixing up the various patrônymics, may be inferred from the fact that the ubiquitous family of "Smiths" is represented by nearly one thousand names; while the Joneses, the Browns, the Williamses, and some others, contribute a proportionately large contingent.

Near this division of the premises is the Flower Seed and Bulb Department. As affording an illustration of the variety of seeds here kept, it is worth stating that the prices of these seeds range from a few pence to two hundred guineas an ounce!

Adjoining is the Vegetable Seed Department,—a room of immense proportions, being 160 ft. long, 30 ft. wide, and 20 ft. high. Millions of packets are annually made up here and supplied to customers, and it is in this room that, as before stated, 2,000,000 packets can be seen at one time in anticipation of the busy season. The most scrupulous attention is paid to the work of cleaning the seeds by special machinery, for Messrs. Sutton & Sons make it their conscientious endeavour to send out none but pure seeds, of definite vital or germinating power.

After passing through a long range of other store-rooms set apart for beans, peas, carrots, parsnips, &c., we next reach the Farm Seed Order Room, also figured in our "cut." This apartment is even larger than either of the foregoing, measuring 180 ft. in length and 60 ft. in width. Here are stacked an apparently endless array of sacks, labelled inside and out, and filled with the various seeds required by farmers, from the smallest up to the Mangel Wurzels. As elsewhere, all orders, after having been made up, are checked by the head of the department. Adjoining this room are several others filled from floor to ceiling with sacks and bags, of which hundreds of thousands are annually used. The Seed Potato Store is also conveniently near, wherein every variety of the tuber is represented, and, notable amongst them, are special kinds,—such, for instance, as Sutton's "Magnum Bonum," Sutton's "Reading Hero," and others no less renowned for their excellent flavour and disease-resisting qualities.

The Farm Seed Warehouse is a spacious building of four floors, which affords some 305,000 ft. cubic space. Enormous quantities of Grass, Clover, Mangel, Turnip, and other seeds are here stored. The stock on hand, at the commencement of the season, is sufficient to sow hundreds of thousands of acres of land, so that some conception of the marvellous extent of the Firm's transactions in agricultural seeds alone may thus be formed.

The Export Packing Department next engages attention. A glance round this room bears out what we have just said as to the Firm's seeds being in high reputation abroad as well as at home. Here are seen cases and packages destined for the Australian Colonies, for the East and West Indies, for Africa, for Japan, and for pretty well every kingdom in the different quarters of the globe. The system of packing adopted is specially contrived to insure the seeds and bulbs reaching their destination in as perfect a condition as when despatched, and with that object special contrivances are employed such as are not in use in any other establishment.

In the Seed Trial House every consignment of seed that is received at the establishment is examined,

and a number of seeds are taken out of each bag and sown, in order to fully test their vitality and ratio of growth, of both of which points a full record is kept. A Modelling Room is also provided on the premises. Here a staff of artists is employed in producing the exact representations of roots, vegetables, &c., so generally admired at the various International Exhibitions, and many of which are also contributed by Messrs. Sutton & Sons to some of the Public Museums; as, for instance, to illustrate the Food Collection, formerly at South Kensington, and now in the Bethnal Green Museum, as also at the Royal Agricultural College, Cirencester, and the principal Museums in India and the Colonies.

We must now say a word or two concerning the Experimental Seed Grounds, covering some fifty acres. The whole is divided into suitable plots, and all the different kinds of Grasses, Cabbages, Cauliflowers, Turnips, Carrots, Parsnips, Swedes, and other farm and garden produce, are tested as to their growing capacity and habits. Samples of "stock-seed" from specially-selected varieties are also grown, as well as flower-seeds. For the latter purpose, however, special Flower-seed Grounds are provided, where at the proper

season of the year a magnificent display is made of flowers in their most gorgeous array, presenting a loveliness and breathing a fragrance simply enchanting.

Thus far we have only dealt with the business. Messrs. Sutton & Sons have not, however, been so absorbed by the superintendence of this gigantic establishment as to be unmindful of the interests of their large staff. On the contrary, every provision has been made for the mental and physical welfare of those in their service. A library and reading-rooms are provided, as well as other accessories for recreation, both in and out of doors. At no great distance from the business premises one of the partners has built a handsome lecture-hall, seating over a thousand persons, where a morning service is held every day; while at the cost of another partner has been erected a spacious restaurant, where most kinds of refreshment can be obtained at very moderate charges. These are only a few of the many acts by which Messrs. Sutton & Sons are constantly manifesting their personal interest in and care for those in their employ.

In confirmation of what we have already said as to the foremost position occupied by this Firm, we may mention that Messrs. Sutton & Sons' seeds and roots have been distinguished at every International or other Exhibition at which they have been shown; and the awards which have fallen to their share include

a long list of Gold and Silver Prize Medals, while at the Paris Exhibition of 1878 the Cross of the Legion of Honour was conferred upon Mr. Martin John Sutton, the managing partner. More than this, the Firm enjoy the high distinction of being the first to be appointed, by Royal Warrant, Seedsmen to Her Majesty the Queen and to H.R.H. the Prince of Wales.

There is quite a large literature connected with Messrs. Sutton's business, and their publications include a valuable work on "Permanent and Temporary Pastures," written by Mr. Martin J. Sutton, a book of standard value on this important subject, dedicated by special permission to H.R.H. the Prince of Wales. Several other works have been published by the Firm, such as "The Culture of Vegetables and Flowers from Seeds and Roots," Sutton's "Amateur's Guide in Horticulture," Sutton's "Farmer's Year-Book," and Sutton's "Autumn Catalogue of Flower Roots," &c., all of them richly illustrated. The circulation of the three last-named alone approximates annually to 150,000 copies.

In bringing these notes to a close, it only remains for us to add our tribute of wonder and admiration at the energetic perseverance which has enabled Messrs. Sutton & Sons to build up and bring to its present state of marvellous development the Royal Seed Establishment,—a business which has not its equal in any other quarter of the globe. The concern affords, indeed, a most striking illustration of the great value and high importance that attach to little things, such as a mere grain of seed; and in this respect, too, a visit to this model Seed Establishment at Reading is interesting and instructive, and affords food for profitable contemplation.

Messrs. Osborne & Co., London.

EXPERIMENTS made with a view to ascertain the effects of friction between different substances, have given interesting and somewhat curious results. It appears that, provided other conditions remain constant, the heat produced varies with the hardness of the material employed; and that when two substances are used of different degrees of hardness, the greater the difference between them the less will be the heat generated. In the case where the substances differ in point of hardness, it is found also that the harder of the two is the one which heats the most; for instance, when friction takes place between bronze and cork, the amount of heat received by the one substance is to the amount received by the other as four to one. In the manufacture of bearings for heavy machinery it is, of course, of the utmost importance to secure durability as well as to avoid heating; and, consequently, the metal of which the bearings are composed should be as hard as possible without endangering the arbor. Briefly speaking, the points which it is most essential to secure in heavy bearings are these: that heating shall be avoided even when lubrication fails, that the bearing shall be capable of resisting any shocks it is likely to be subjected to, and that the greatest possible durability shall be insured.

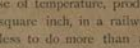
Much care is needed in the production of alloys for the above-mentioned purpose in order to secure their homogeneity; and any one, therefore, who invents a new and superior compound, or manufactures an alloy of uniform quality, combining the maximum degree of tenacity with the greatest capacity of resisting friction, is deserving of the sincere gratitude of the engineer.

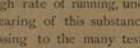
From a table of results which lies before us, it appears that immense differences exist in the suitability for axle-bearings of many of the alloys commonly used for the purpose. In this table are given the distances which the different bearing metals will run before being renewed; and whereas for gun metal, white metal, and lead composition, these range only from about 27,000 miles up to rather more than 39,000, the greatest distance on the list is no less than 171,000.

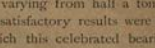
It is to the manufacture of metals adapted for axle and other heavy bearings that the Firm of Osborne & Co. have long given special attention; and when we state that the wearing powers of their well-known "Slidon" exceed those of even the best of the metals mentioned in the aforesaid table, it will be seen how much the engineering world is indebted to this Firm. Among the many other goods they turn out from their Works are two metals which have a great name as wear-resisting and anti-friction substances, and of which they are the sole owners and manufacturers. The one, which is the "Slidon" we speak of, is specially recommended for slide valves, slide faces, and, indeed, for all wearing parts of machinery; the other, which is the celebrated "Taylor's Special Bearing Metal," is declared to be the cheapest and best anti-friction compound made, lasting longer and working cooler than any other. It runs more freely than even "Babbitt's metal," which it resembles in appearance, and is extensively used for lining up the large bearings of locomotive axle-boxes, and

for other similar purposes. Of the many advantages that are claimed for it, one of the most important is, that by imparting a coating of its own substance to the shaft or journal, and so reducing friction to a minimum, it not only lessens the necessity for constantly oiling the bearing, but economises steam power and preserves the machinery at the same time. As the metal can be melted and poured straight into the plummer block, there is no difficulty about the process of re-lining. The plan adopted by Messrs. Osborne & Co. is to employ a bronze metal for the shell or backing, and to line it with Taylor's metal. In tests which were made for ascertaining the increase of temperature, produced by a high rate of running, under pressure varying from half a ton to three tons per square inch, in a railway-carriage bearing of this substance, the most satisfactory results were obtained. It is needless to do more than allude in passing to the many testimonials which this celebrated bearing metal has obtained.

The business of Messrs. Osborne & Co. was established about fifty years ago, by Mr. Barrett, in Skinner



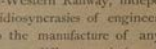
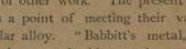


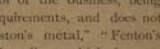


Street, and afterwards came into possession of the late Sir Charles S. Osborne. When the premises in Skinner Street were required by the Great Eastern Railway Company for their new station, a new foundry was erected in Great Garden Street, London, E., where the work has ever since been carried on. The business, which is now the property of Mr. P. J. G. Rouquette, one of the founders of the Phosphor Bronze Company, Limited, consists generally in mixing metals, and making special alloys and castings for every purpose—from a cannon to a propeller, and from a gun-racer to a thermopyle. Besides bearings of every description, which have been made a specialty, such things as pinions, bells, calico-rolls, pumps, liners, all railway, dock, rolling-mill and steamship work, and ornamental castings, are turned out from the works in Great Garden Street. Brass, bronze, copper, and

white metal castings of every variety, are produced, from patterns or in loam. As much as twelve tons of castings a week can be made, besides ingots. Large contracts are undertaken by the Firm for docks, railway companies, and engineers; and in a single year no less than eighty-nine tons of bearings alone were supplied to the South-Western Railway, independently of other work. The present proprietor of the business, being familiar with the idiosyncrasies of engineers, makes a point of meeting their various requirements, and does not confine himself to the manufacture of any particular alloy. "Babbitt's metal," "Kingston's metal," "Fenton's metal," and the many different varieties of bronze, brass, and white metal, are among the alloys which he manufactures, besides Taylor's metal and Slidon, already mentioned.

Large shipments of metal, principally anti-friction compounds, are made by Messrs. Osborne & Co. to



numerous foreign parts, including Brazil, China, India, the Cape, Australia, New Zealand, Germany, France, Sweden, Norway, Turkey, Italy, Spain, and Denmark. The greatest care is taken to employ only the best material and workmen on the premises. The foreman of the works stands second to none as a practical moulder, having been in the employ of many well-known Firms, such as Messrs. Seward Brothers, of London; Messrs. Hopkins, Gilkes, & Co., of Middlesbrough; Messrs. E. R. & F. Turner, of Ipswich, and others. The head fireman, too, has been with the Firm for twenty-seven years, and thoroughly understands the temperature at which the different alloys should be drawn from the furnaces—a most important matter. There is little therefore to be surprised at if the business maintains its reputation, and if important castings, which require to be perfectly sound and without the smallest defect, are sent to be made by the Firm of Osborne & Co. The alloys and castings of this Firm made a splendid show at the Engineering and Metal Trades' Exhibition, which was held at the Agricultural Hall, in July, 1883.

Messrs. Taylor Brothers, Leeds.

ESTABLISHED in the year 1868, the business of Messrs. Taylor Brothers of Leeds has made such uniform and rapid progress, that no less than four successive moves to more extensive premises have already been rendered necessary. The original establishment was in East Parade, where a few hand-presses were employed in plain, ordinary work; the first move was made to Wade Street, whence the business migrated to St. Ann's Street, and thence to Hunslet Road; and, finally, the buildings now occupied in Sovereign Street were engaged by the Firm. From this address their fame as wholesale and export publishers of chromo-pictorial almanacks, and as chromo-lithographic printers generally, has spread far and wide. The present premises consist of a large four-storeyed building, with a machine-room of enormous dimensions added on the east side. This commodious machine-room is a hundred and thirty-seven feet long, by seventy wide, and contains twenty-eight of the most modern and improved lithographic and letterpress printing machines, ranging from quadruple crown to the smallest useful size. Among the other machines in the room are those for ink-grinding, dusting-off, bronzing, &c., to all of which power is supplied by a forty horse-power condensing engine of the newest and best construction. For generating the steam, two large boilers of forty horse-power each are employed, the steam from which, in addition to supplying the engine, is utilised for warming the whole of the Works, as well as for heating the glue used in almanack sticking, bookbinding, &c. Over the boiler-house, in order to economise heat and consequently fuel, are located the drying rooms, where such work or materials as require to be dried are placed for a longer or shorter time.

A somewhat novel feature about the establishment is the dining-room, where the employés, if so disposed, can take their meals, instead of returning to their homes in the middle of the day. For men who live at a distance from the Works this must be a great convenience, to be highly valued. The dining-room is situated at one end of the machine-room. Of the artistic department, to which we shall revert presently, we may here remark that the arrangements are very complete, and that every device is there adopted, as, for example, the use of Day's Shading Mediums, &c., to facilitate the execution of artistic work. An excellent staff of skilful designers and artists is here maintained, and many of the designs turned out are highly artistic productions. Continuing to describe the various portions of the establishment in order, we may mention next the warehouse, which, like the other portions already referred to, is on the ground floor; here are stored plain papers, grocery papers, and numerous other goods. On the ground floor also are the counting-house, the private offices, and the time-keeper's office. Like so many other large manufacturers of the present day, Messrs. Taylor do most of their own repairing, and their Works, as far as possible, are self-contained. They have their own joiners' and mechanics' shops, where nearly all the breakages in the machinery can be made good and repairs executed. These departments also are on the ground floor.

Ascending to the upper portions of the building, we find the second floor given up to the cutting-

machines, the label-punching machines, the apparatus for gluing almanack mounts, &c. The third floor is devoted exclusively to printed stock; and the fourth floor to account-book making, bookbinding, paper-ruling, and the various processes connected with these departments. Throughout the Works the most improved machinery is everywhere employed, and every effort is made to economise labour in all directions. No trouble or outlay is grudged by the Firm that enables them with greater certainty to meet the constantly varying demands of the public, and, in the long run, to produce their goods at a less cost, and thereby to offer them at a lower price. All the arrangements for the manufacture of the articles they turn out have been brought as near perfection as trouble and money can very well bring them, and scrupulous cleanliness and order are characteristic of the Establishment. In many printing-offices waste paper is always littered about the floor; but not so here, where every piece is carefully removed, and the strictest neatness and tidiness are everywhere observable. The boys whose duty it is to clean and polish the machines are encouraged to take an interest in their work by the award of weekly prizes for the cleanest and brightest machines.

It would probably astonish William Caxton, the introducer of the art of printing into England, could he rise from his grave and take a peep into the Steam Colour Printing and Lithographic Works of Messrs. Taylor Brothers, of Leeds. Invaluable as the services of Caxton have been to the country, his wooden printing press and black letter type would present a strange contrast to the complicated machinery and appliances by which the beautiful work done at the above establishment is produced. To give a history of the art of printing would be altogether beyond our scope; but it may not be out of place to note here, very briefly, some of the principal points in the history of that invention which, starting from the simplest beginnings, has culminated in such establishments, amongst others, as the one under notice, and has helped in so marvellous a degree to bring about our modern civilisation. Little more than four hundred years has elapsed since the invention of movable types; but for centuries, and probably even for thousands of years, prior to that date the art of printing from blocks had been practised in a rude fashion. Bricks are found in the ruins of Babylon on which symbolical figures and hieroglyphical characters have been impressed, and the Chinese have long been accustomed to print with wooden blocks. The Chinese, with their strongly conservative tendency, still employ their old method of printing. Having written the matter to be struck off on one side of a sheet of semi-transparent paper, they glue this with its face downwards on to a block of wood. The engraver then cuts away the wood around the characters, leaving the latter in relief, and ready for printing. A similar method was adopted in Europe about the end of the fourteenth century for printing playing-cards and rough pictures of Scriptural subjects. As to the invention of movable types, it has never been decided with absolute certainty who deserves the credit of it, although not improbably the invention was made by Gutenberg about the year 1440. The origin of the story of Faust and the Devil is said to have been connected with the introduction of printing; Fust, one of the partners of Gutenberg, having produced books with such rapidity that he was accused of having called in the aid of the Evil One. At first the printing-presses resembled wine-presses, and any colouring or ornamental work in a book was done by hand. In course of time, however, the press was gradually improved by William Jansen Blaeu, the Earl of Stanhope, Nicholson, and many other ingenious inventors, until it has now been brought to an extraordinary degree of perfection. Nor has less progress been made in regard to the blocks and types with which the actual printing is done. Among the most important improvements in the art have been the introduction of colour printing and the invention of lithography; and to the development of these two branches of the art is mainly due the existence of such a business as that of Messrs. Taylor Brothers.

The invention of lithography, or the process of printing from stone, was made by Aloys Senefelder, of Munich, nearly a century ago. It consists in transferring, in the first instance, to a particular kind of stone a copy of the drawing or writing in an unctuous composition; those parts of the stone covered with this composition then retain their natural power of receiving printing ink, while the remainder is prevented from doing so by means of a mixture which is poured over the whole sketch or writing. The ink having then been applied, copies can be taken on an absorbent paper laid on the stone and subjected to pressure. Solenhofen and Kelheim, in Bavaria, produce the best lithographic stone, but inferior qualities have been found in England, France, Canada, and elsewhere. To fit them for use, the stones are ground level with sand, and according to the purpose for which they are required either polished with pumice and water-of-Ayr stone, or given an artificial grain by means of ground glass or fine sand.

Although other kinds of printing also are done by Messrs. Taylor, lithography in all its branches is their specialty. A far greater degree of skill is necessary for this class of work than for the work of the ordinary printer;

and the fact that the business though already extensive is still increasing is pretty clear proof that the requisite skill is possessed by the workmen in Messrs. Taylor's employ. Much of the work turned out, both from an artistic and from a mechanical point of view, is deserving of the highest commendation, and is continually receiving favourable notice in the journals devoted to the printing, stationery, and other trades. In the store-rooms, the original formes of all the finer work are carefully preserved; and throughout the lithographic department the closest supervision has constantly to be exercised. No trouble is spared to turn out the work with the utmost precision; and whether in regard to the paper, the inks, or the colours, every care is taken that the materials shall be in exactly the right state to work with. The proprietors of the concern are men who take a keen interest in their work; and in this no doubt lies in a great measure the secret of their success. In a chromo-lithographic business, so much depends on the artistic instinct of the principals, that unless these enter heartily into the work success is hardly possible. With a view to economy, the Firm have erected a mill expressly for the purpose of grinding their own colours; they also take the greatest care in levelling and re-polishing their stones, the apparatus for accomplishing which is singularly ingenious. Three bronzing machines are employed on the premises. The patentees of these machines are Messrs. Leeming, Ray, & Lynde.

At the Steam Colour Printing and Lithographic Works of Messrs. Taylor Brothers, a very large business is done in the pictorial almanacks and calendars which have come so much into vogue of late. Every one is acquainted with the tastefully designed and carefully executed almanacks with which shopkeepers are so liberal to their customers at Christmas time; and of these and similar ones some two million and more are produced annually at the above Works. Particular attention is devoted to this branch of the business; and, although valuable and expensive paintings are purchased for reproduction, the annual sale of such an immense number of copies enables the Firm to offer the almanacks at prices which most other Firms cannot approach with the same quality of goods. Over fifty new designs are produced every year, which is considerably more than the number produced by any other maker in the world. In addition to the paintings purchased by Messrs. Taylor Brothers, they also keep their own staff of artists and designers, as previously mentioned. It might have been supposed that to bring out novel designs in almanacks and calendars was well-nigh impossible, after so much ingenuity has already been devoted to the matter; but somehow or other the feat is accomplished year after year at these Works.

An immense advance has been made of late by the public in regard to artistic taste, which renders the supplying of almanacks that shall be regarded as ornamental appendages to the walls of private houses a far less easy task than it was but a short time since. Messrs. Taylor Brothers, however, are in a position to keep pace with the improvement in public taste, and not only produce novel designs each year but render their almanacks sufficiently artistic to be acceptable presents to shop-keepers' customers and the public generally. A few of the most effective designs which have been brought out in recent years may perhaps be worth special notice. "The Pride of the Coast" was taken from a painting by Mr. Baldry, an exhibitor in the Royal Academy; it represented a beautiful girl returning from her daily employment by the sea-shore, and was truly a work of art. "Our Old English Homes" was a series of pictures twenty-eight inches by twenty; the subject of the first was a house belonging to the Duke of Rutland, noted both for its architectural beauty and for the exciting incidents which have there taken place. It gave a moonlight view of the house, and having a rich gold border, presented altogether a highly picturesque and artistic appearance. The lights shining from the windows were exceptionally well done. Another taking design was "The Fair Tennis Player," representing a young lady resting after her game, and reclining her head on her racket. "Henry Irving and Ellen Terry," and "The Christian Martyr" were two designs that were spoken of in terms of high commendation; and "Dirty Weather Ahead" also attracted some notice. "Moonlight at Sea" was treated in such a manner that the moon's rays, the white billows, and the ship in full sail together produced a remarkably fine effect.

It cannot be complained that the various manufacturers, whose business it is to supply the wants of the printing-office, do not, as far as they are concerned, contribute what they can towards making a high standard of excellence in printing attainable. But the smaller printers are greatly aided in certain classes of work by such a house as the one to which this article is devoted. A large trade is done by Messrs. Taylor Brothers in ornamental borders which are printed on paper and cards of various sizes; these are sold to printers who have not the same facilities as are possessed by Messrs. Taylor for doing ornamental work, or who only desire to strike off a limited number of programmes, circulars, posters, &c. The blank central space can of course be filled in as required. In this way any printer is enabled to turn out artistic work in small quantities at a cost very little above that of plain work. The ornamental borders are printed on sheets of ordinary writing

or printing paper, adapted for placards, circulars, &c. Previous to the introduction of these partly printed sheets to the trade, it was impossible for a printer to turn out an ornamental programme or the like, of which but a few copies were required, on anything like moderate terms. A fresh design had to be got out for each job, the cost of which was naturally very heavy. Indeed, there were not many houses that could turn out such work at all, since the chromo-lithographic business is conducted only in some of the largest establishments. Another advantage too is gained by the practice we are speaking of in addition to the saving of expense, namely, that even very ordinary work, when set off by these artistic borders, becomes quite passable.

Concerning the designs for the borders, much the same may be said as concerning the designs for the almanacks and calendars; they are highly artistic, and not so obtrusive as to draw off attention from the verbal matter within. We may quote on this subject the words of Mr. S. C. Hall, late editor of the *Art Journal*, and an authority on matters of the kind. Mr. Hall pronounced the productions of Messrs. Taylor to be "good designs and excellent specimens of art." The bordered posters, programmes, circulars, window-bills, and the like are produced in many different styles. Most of the larger bills are on white paper, and the borders around them are in different colours; as, for instance, green, brown, red, blue, and orange. Floral, rustic, and Mediæval designs are among those employed. The size of the sheets on which the borders are printed varies from demy-folio to double-demy. It must be obvious to all how advantageously these bordered sheets may be utilised by printers, especially when it is stated that the price is very little above that of the paper itself. A better example could hardly be given of the benefits mankind derive from division of labour.

The remarkable success which has attended Messrs. Taylor Brothers' business is largely due, as we have said, to the interest taken by the principals in the work, and their care to see that the materials used are put to the best possible advantage. No work from the artists' rooms is ever allowed to be finally placed on the stone until the colours perfectly harmonise, in order that the most artistic effect may be obtained. It is, of course, a great thing to have a regular staff of designers and artists on the spot, working in concert with the other employés.

In addition to the almanack and printed-border trade, a large business is done by Messrs. Taylor Brothers in show-cards and labels, as well as in other work which they execute, not only for England, but for many of our Colonies, including Australia, the West Indies, and New Zealand, and also for foreign countries, including Holland and Italy. The variety of goods which they turn out is very great; they print certificates for schools, as well as for temperance societies and general institutions; these are particularly well designed, and the brilliancy and evenness of the colour are specially noteworthy. They also print by the lithographic process such things as covers to guide-books, special trade calendars with local illustrations, and office and pocket calendars. In Christmas, Easter, and birthday cards, too, they do a large business, taking contracts to supply the trade. But we have not yet exhausted the list of goods, or even of classes of goods, which the Firm produce; they have given their attention also to the facsimile reproduction of oil and water-colour paintings, a branch of industry which may not improbably grow to very large proportions; and they also turn out presentation-pictures, to be distributed along with newspapers and magazines. Then, again, they print illuminated and floral texts, and produce various fancy goods, besides those already mentioned; indeed, they do all varieties of high-class chromo-lithographic work, from an insignificant little price-list to a large and expensive wall-picture. They supply the wholesale trade, publishers, and manufacturers; and their foreign and colonial trade is an extensive and highly important one. It is their special desire to still further increase their connexion abroad; and, by the aid of moderate charges and the prompt and careful execution of orders, they are successful in constantly enlarging the field of their operations.

We must not conclude this article without mentioning that Messrs. Taylor Brothers do also a general printing and bookbinding business, as well as other miscellaneous work. The letterpress printing is mainly in connexion with such things as catalogues. Nor must we neglect to state that the coloured vignette of the Queen which appears as a frontispiece to this ALBUM, is the work of the above celebrated Firm.

Messrs. John G. Crace & Son, London.

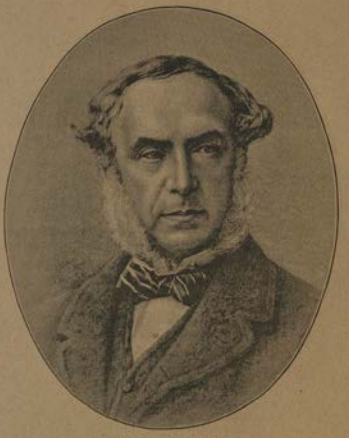
THE Firm of Messrs. Crace & Son have, for nearly a century and a half, held a leading position among decorative painters, without ever admitting a partner of different lineage within their circle.

Edward Crace, the founder of the business, was born in the year 1725, during the reign of George I. His father was Thomas Crace, described as "citizen and coachmaker" of Westminster, and his grandfather on his mother's side had been surveyor of Westminster Abbey. When about sixteen years of age, young Crace was bound apprentice to an artist, and he thus obtained a training well calculated to fit him for the business of house-decorating, which he entered upon in 1750. Two years previously he had been admitted to the freedom of the Painter Stainers' Company, and in 1752 he was admitted to the livery. A year or so later he married an artist's daughter, a circumstance which helps in some measure to account for the artistic taste which his descendants have displayed. In those days James Wyatt was the leading figure in the architectural world, and about the year 1773, or a little earlier, he adapted the Pantheon, in Oxford Street, for dramatic performances. One of the principal tasks which Edward Crace undertook, and successfully accomplished, was the decoration of this building; but perhaps better testimony to the reputation he acquired was his appointment, in 1780, to the responsible post of Curator of the pictures in the Royal Palaces. This important office he held for many years; until at length he died, in 1799, at an advanced age, and his place at the head of the Firm was taken by his son, Mr. John Crace.

Born in 1754, this gentleman had long been associated with his father in the business, although at one time a split had been brought about between them by the runaway marriage of the son. John Crace had then started on his own account. He was noted for energy and other desirable qualities, as well as for intense love of art. Among the great architects with whom he was contemporary were Sir Robert Taylor, Sir William Chambers, who built Somerset House, James Stuart, the well-known classic architect, and Sir John Soane, whose house and valuable collection of antiquarian treasures, bequeathed for the use of the public, are now known as the "Soane Museum." Each one of these celebrated architects entrusted John Crace with important work, as did also George III. and the then Prince of Wales. Besides other public buildings, he helped to decorate the Opera House, Drury Lane and Covent Garden Theatres, and Carlton House. At the age of sixty-five he died, and was succeeded by his son, Frederick Crace, grandson to the founder of the business. Under the superintendence of this third head of the Firm the uncompleted work at Carlton House was finished, and the celebrated Brighton Pavilion was decorated for the Prince Regent, afterwards George IV. A good deal of decorative work was done in Windsor Castle also during the reign of the last of the Georges, who apparently was well pleased with the manner in which Mr. Frederick Crace accomplished the task. Concurrently with the execution of these and other commissions for Royalty, the private connexion of the Firm rapidly increased, and

the mansions of many of the chief among the nobility are indebted for much of their decoration and ornament to one or other of the Crace family. Mr. Frederick Crace was born in 1779, and died in 1859, at the age of eighty. From 1806 to 1812 he lived and conducted his business at 34, Curzon Street; but subsequently he resided out of town, while carrying on business at 51, Great Queen Street, in partnership with a younger brother. During the latter part of his life he gave much of his time to forming a collection of maps and views of London; and so important did this collection become, that, in 1881, it was purchased on behalf of the nation by the trustees of the British Museum.

About the year 1826 the business had grown to such proportions that the assistance of Mr. John Gregory Crace, the present head of the Firm, and son of Mr. Frederick Crace, was called in by his father. At this time, also, the Great Queen Street premises were relinquished, and fresh ones taken in Regent Street; but another move followed almost immediately, and the premises in Wigmore Street were then taken, which have ever since



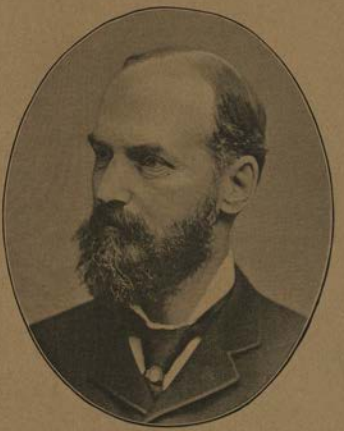
MR. JOHN GREGORY CRACE.

been occupied. Mr. J. G. Crace was born in the year 1809, and after 1826, in conjunction with his father carried on the business for many years on the old lines. He began to perceive, however, that this country was not taking her proper position in the world of art; and in 1840 he determined to travel on the Continent in order to examine into the artistic styles and schools of Germany and Italy, as well as into those of France, with which he was already, to some extent, acquainted. In these countries he made a careful study of the best examples of art-work, both ancient and modern. On his return to England he engaged the most skilful artists he could obtain, and commenced to carry out work of a higher class than either he or others had previously attempted. English art was at that time in a very backward state,—the British public were content with the most commonplace colouring and designs,—and to indulge in white and gold was considered the very height of æsthetic refinement. It will easily be understood, therefore, how great a stir was created in art circles when Mr. Crace began to introduce French and other foreign ideas into his work. A profound impression was made on the minds of the cultivated classes, especially by Mr. Crace's decorations in the style of the early French Renaissance; and his ideas being taken up and his example followed by others, a great impetus was given to the tendency, just beginning to show itself, to indulge in a more attractive and truly

artistic style of decoration. The principal show-room in the Wigmore Street establishment was then decorated in the style just mentioned—that of the French Renaissance.

About the same time, also, Mr. Crace made an important addition to his business in the shape of a furnishing department. He had observed, what others must often have observed too, that when the decoration and the furnishing of a fine building are in different hands, the result is often far from satisfactory, owing to the want of harmony between the ornamentation of the building and the furniture. It was therefore a wise move on his part to bring together under one management the business of decorating and that of furnishing. Nor was he content merely to act as a dealer in furniture, and to select his goods from the stocks of other manufacturers which might not always be exactly to his taste. Accordingly, he started his own workshops, and began the manufacture of furniture that harmonised with his decorations.

In 1843 and following years several magnificent mansions belonging to the nobility were beautified



MR. JOHN D. CRACE.

by the taste and judgment of Mr. John G. Crace, who at that time was still but the junior partner in the business. Among these edifices were Chatsworth—the palatial residence of the Duke of Devonshire—and Devonshire House, belonging to the same family. The Marquess of Breadalbane also called in his services at Taymouth and in London; and among the many public buildings which the Firm decorated about this period may be mentioned St. James's Theatre.

Another tour to the Continent was undertaken in 1846, on which occasion Mr. Crace gave most of his attention to the restored Sainte Chapelle in Paris, and the châteaux of Blois, Chambord, and Chenonceaux. The château of Blois was then undergoing repair, and he obtained permission to carefully inspect the designs and colouring of the decorations. On his return he gave the public the benefit of his tour of inspection, by reading before the Royal Institute of British Architects two papers containing the results of his travels.

No trifling distinction was conferred upon Mr. Crace when, in 1848, he was selected by the Government, on the recommendation of Sir Charles Barry, to execute the coloured decorations in those magnificent buildings beside the Thames at Westminster—the Houses of Parliament. His father who, as we have said, lived until 1859, was now becoming old; and the management and direction of this important and extensive work

fell entirely to the lot of the son, Mr. John G. Crace. Under the influence of Pugin, with whom he became acquainted while engaged on this work, he began to be much interested in the "Gothic revival," and took the matter up in his hearty and thorough-going way. Nothing would satisfy him until he had mastered in detail the styles of decoration in vogue in the Middle Ages, and had applied his knowledge of those styles to the manufacture of furniture. Specimens of the mediæval work which, with Pugin's aid, were turned out from the workshops at this time are still thought highly of, notwithstanding the general progress which has been made since then in the manufacture of furniture in artistic styles. Of the many important buildings which the Firm were engaged in decorating about the middle of this century, we may mention a house in Hyde Park Gardens for the brother of Sir Robert Cockerell; the mansion of the Duke of Hamilton in the Isle of Arran, of Sir Norman Lockhart at Lanark, and of the Duke of Devonshire at Lismore; Chirk Castle in North Wales; Sherborne Minster, and many other churches; Leighton Hall at Welshpool; and—to add another to the list of buildings which they decorated for the Duke of Devonshire—the mansion belonging to that nobleman at Chiswick.

We are now arrived at the time of the Great Exhibition of 1851, in promoting which Mr. John G. Crace was one of the first to take an active part. In conjunction with Pugin he decorated the Mediæval Court; and, along with Lord Ashburton, Mr. Jackson, Mr. Webb, Mr. Snell, and Mr. Aubert, he was deputed to adjudicate on the furniture and works of decoration in the Exhibition. His name was included also on the list of Special Commissioners. On the removal of the Exhibition buildings to Sydenham, where they have since been known as the Crystal Palace, Mr. Crace was selected as one of the architects to superintend the internal adornment of the structure; and it was he who designed the Queen's private apartments in the building, which, unfortunately, were afterwards destroyed by fire. Two or three years after the date of the Great Exhibition, he was commissioned by Prince Albert to furnish a suite of rooms in Windsor Castle, set apart for the reception of Napoleon III. and the Empress Eugénie during their visit to the Queen. While this work was in hand, Mr. Crace had the misfortune to be taken seriously ill; but even when laid on a bed of sickness and in danger of losing his life, he continued to make the necessary arrangements for the furnishing and adornment of the royal apartments. By this time his son, Mr. John Dibblee Crace, was old enough to take some share in the business; and, with the help of his son and his aged father, Mr. J. G. Crace was able to get through the work he had undertaken.

In 1857 the "Art Treasures Exhibition" was held in Manchester, and Mr. Crace was engaged to design and execute the coloured decorations for the building. Some three or four years later, Prince Albert, who had been specially struck with the Manchester decorations, again secured his services to beautify the "Waterloo Chamber," as the great banquet-hall of Windsor Castle is called.

In 1859, when the *Great Eastern* was nearing completion, the decoration of the saloon of that celebrated vessel was entrusted to Mr. J. G. Crace. The greatest care and skill were bestowed on this work. While the vessel was on her trial trip, a terrific explosion occurred on board, which caused much loss of life, and utterly wrecked the magnificent saloon so tastefully decorated by Mr. Crace. He himself on this occasion very narrowly escaped with his life.

It was in this year, 1859, and within a few days of the explosion on the *Great Eastern*, that the aged Mr. Frederick Crace breathed his last. In the same year, also, Mr. J. D. Crace, then quite a young man, undertook a journey to Italy, for similar objects to those which had taken his father, Mr. J. G. Crace, there. He carefully studied the Italian styles of art, and brought back with him fresh ideas and numerous sketches, as a result of which there has been a touch of the fine Italian character about the work of the Firm since that time.

The important buildings on which the Firm have been engaged in recent years are far too numerous to be all mentioned here; but among them we may name Bestwood, belonging to the Duke of St. Albans; Ickworth, the seat of the Marquess of Bristol; Longleat, the seat of the Marquess of Bath; the Mercers' Hall; and Grosvenor House, belonging to the Duke of Westminster. They have also done notable work for Viscount Gough, Sir John Amory, Mr. Snowdon Henry, and many other gentlemen of distinction. The fame of the Firm, which has lasted through so many generations, is to be attributed to the great artistic judgment, administrative ability, and care for detail which the members of the Crace family have so persistently exhibited. Mr. John G. Crace is now advanced in years; but the son, Mr. J. D. Crace, has abundantly proved his ability as well as his determination to conduct the business in such a way as to sustain the reputation of his ancestors. His latest work is the decoration of the new rooms and Grand Staircase of the National Gallery, now about to be thrown open to the public.

Messrs. Liberty & Co., London.

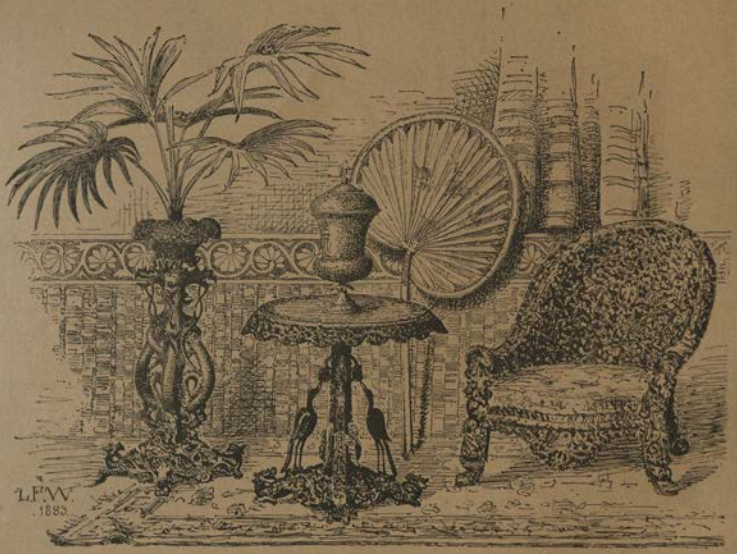
FOREMOST amongst the improvements which have made their mark upon the last half century are undoubtedly those connected with Dress and Furniture, and with the advance made in this direction the name of Liberty is inseparably associated. "Eastern Art," in its application to modern requirements, owes its commercial development to the untiring energy of Mr. Lasenby Liberty, who, since the great International Exhibition of 1862, has done more than any one else to foster this branch of Household Art. Japanese goods were, about this period, first procurable, and it was in connexion with the Japanese exhibits at this Exhibition that Mr. Liberty obtained his first appreciative feeling for the decorative beauties, and dainty subtleties, of what was then an absolutely new world of art. Business duties, as an employé, brought him in contact with clients whose opinions were cultured; and particularly with those who had regard for the Decorative Arts. Those first Japanese imports stand out as examples of what was best and choicest from the lands of Great Niphon. They were the poetry of her art work, and the veriest trifle of Japanese work was then satisfying and complete. This was before the "Westerns," with purely commercial ideas, impregnated the work and manipulative perfection of the children of Japan. Mr. Lasenby Liberty's connexion with the Firm in whose employ he was, and for whom he ultimately managed their "Eastern Art Department," lasted over twelve years.

On the 17th May, 1875, Mr. Lasenby Liberty made his first *début* as an independent trade centre. He opened, at 218A, Regent Street, a small portion of the premises now known as East India House, with a staff consisting of one assistant and one porter. In the preceding thirteen years a change had passed over the art products sent from that quondam fairyland, feudal "Old Japan." The commercial element had stepped in, and a similar fate, that aforetime had gradually and surely deteriorated, cheapened, and vulgarised imports from China and India, was meted out to the last isolated refuge of the elder civilisations, and the products of Japan became "modernised."

At this epoch Mr. Lasenby Liberty's first venture was made, and he set before him two principal objects, viz., to achieve commercial success and to conserve, as far as his influence would permit, the beautiful and unique in the art teachings of the Eastern world, and particularly such as were practical and applicable for European adoption. Through the lack at this period of diffused art feeling in the public the second object somewhat jeopardised the attainment of the former. In relation to conserving the beautiful, it was necessary: to retain or reproduce traditional Eastern colouring; to favour individuality of thought and thoroughness in designs; and to insist upon purity of textures. A Chinese porcelain vase should be modelled in such form as Chinese experience from time immemorial had gradually evolved as the most practical and beautiful of its own peculiar type; it should be decorated in a conventional balance of ornamentation, also the result of the experience of long generations, and the expression of the thought of a Chinese artist's mind; it should be

coloured in Chinese pure rich harmonies; and it should be manipulated from the choicest "China" clays. A porcelain vase, notwithstanding the fact that it may have been actually made in China, should be avoided if it be modelled after, say, a conglomerated Viennese-Greek form; decorated with regard solely to the eccentric and bizarre, a mingling of all influences and all times; coloured with an eye only to the amount of strong contrasts, violent pigments, and ostentatious display of gilding which can be crammed into a given space; and made of porcelain in regard to which the only thought has been cheapness in production.

An Indian shawl should be avoided when it takes its inspiration from the latest fashionable innovation of the "mode Parisienne," to the utter loss of its individuality, or the characteristic thoughts of the wearers in the valley of Cashmere.



INDIAN FURNITURE.

Again, Mr. Liberty agreed with those who thought carpets should be selected and valued, in proportion as they approach suitableness in relation to the object of their usage. Intended to furnish and more or less clothe the floor space of houses, they should be ornamented with patterns which the foot may press upon without a feeling of instinctive recoil. If flower or beast form any original motive idea of the design, the treatment should be so entirely conventionalised, that the possibility of any unpleasant impression may be entirely avoided. The colours should be rich, even luxurious; harmonious, not "spotty"; giving a balanced sense of restfulness. Eastern carpets, at this time, were actually more esteemed the nearer they were assimilated to the style and designs of Europe; not, fortunately, that European designs must of necessity be bad, but at this particular period they were, as a matter of fact, wanting in well-nigh all that was appropriate and artistic. Some of the fundamental objects of their manufacture seemed altogether disregarded. Designs were treated

pictorially; shadowed flowers, fair-skinned classic nymphs, dogs, lions, tigers, and all sorts of ferocious nondescript beasts, were unrestfully strewn underfoot. Colours were for the most part glaring and strongly contrasted, and "jute" was used in place of hair and wool.

Comparing the soft harmonious fabrics of carpets of the present day with those in vogue twelve years ago, it will be readily admitted that the artistic influence of Mr. Lasenby Liberty has put its stamp on this furnishing commodity.

Silken and stuff fabrics from the East were also being made for European "taste;" gummed and stiff, cheapened and deteriorated in quality, glaring and fugitive in colours. The former beautiful fabrics—relics of a period when the draping of the human form in such a manner as best to show its grace and contour

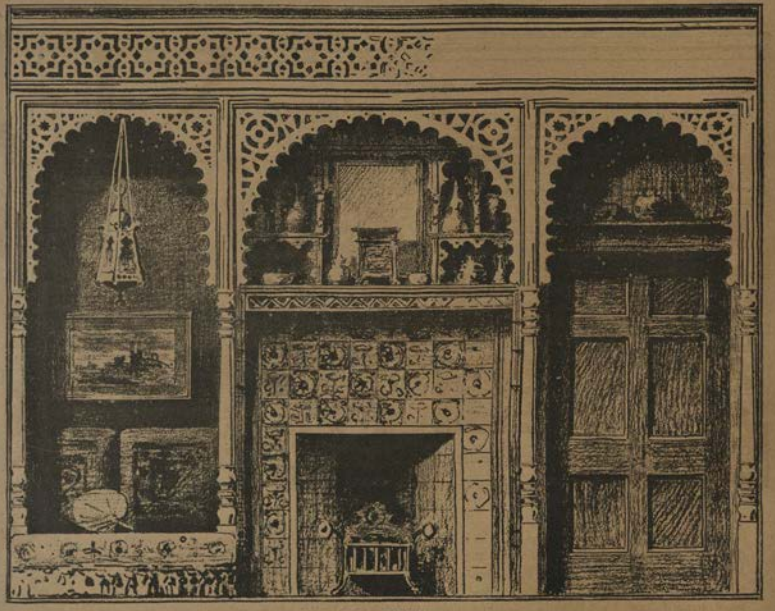
ARAB FURNITURE.

was the essential consideration—were discarded. In place of them, the Orientals were stimulated by traders to produce mere "novelties" or imitations of the worst French school; for French "taste" in fabrics was paramount. Terribly bad colouring was applied to silken and stuff fabrics, and designs had lost all originality; in short, all branches of the Eastern decorative arts and manufactures were threatened with extinction had not Mr. Liberty's timely intervention averted this.

This impending fate was known and regretted by the cultured few, who were for the most part not traders, and so could not greatly aid in arresting the decline. They advised Mr. Lasenby Liberty that if real efforts were made to import and encourage the "right things," it would not only be doing a good work, but would in time prove a commercial success. To this end, then, Mr. Liberty directed all his energy and means.

He met with many discouragements, and no little loss at first, through the incapacity of agents and natives:

they refused to believe that instructions were earnest which directed the production and despatch of wares and staples which, in some form or another, were not "improved" for the Western market. Mr. Lasenby Liberty's principal and most successful efforts have, perhaps, been in relation to silken and stuff goods. In these, technical difficulties of lengths, widths, quantities and accurate "repeats" were so great that it was ultimately found desirable to make a new departure. In some cases it was necessary even to import the raw materials, and after careful study and trials to carry out the finishing manipulation in England. Wherever this was done the utmost diligence was used, never to seek to improve the effects, most satisfaction being felt when a material had been accurately reproduced on the exact lines of the original.



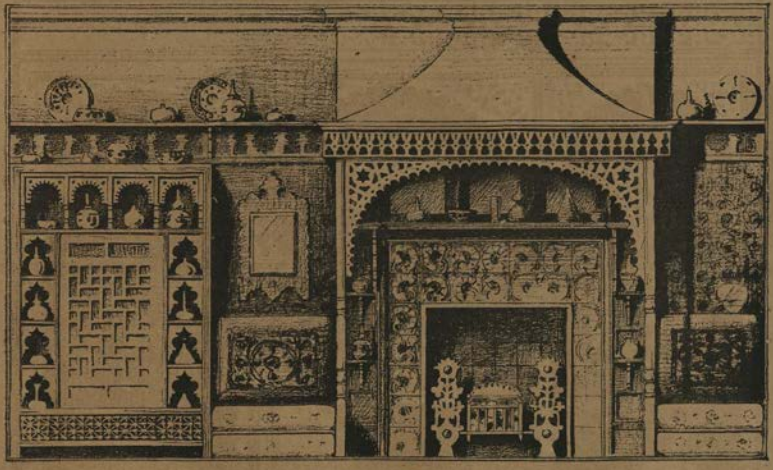
ANGLO-ARAB DECORATION.

Little by little Mr. Liberty made progress with one or the other of his dual aims. Oftimes art had to be subordinated to the needs of commerce, and trade had to be done in goods the style of which did not approve themselves, because shippers and manufacturers would not be troubled with new ideas for small orders; this subordination of art was only tolerated for the sake of its being able in the future to assume a more important and independent position, because when once orders of considerable magnitude can be given, commerce is ready to bend the knee either to art or fashion.

During the first trading year many business relationships were established with correspondents at home and abroad, some of which have since developed into the most valuable aids. And such good progress

had been made that, at the end of two years, about midsummer, 1877, he added to his premises the second half of 218, Regent Street, and, for trading convenience only, changed the name of the business from Lasenby Liberty into Liberty & Co., under which name he has ever since shrouded his individuality. This additional space gave scope for the development of the carpet, stuff, and silk departments.

The latter (silk and dress stuff departments) were, five years later, about Michaelmas, 1882, put upon a still more important footing, and particularly by means of some successful experiments in dyeing Indian silks and cashmeres; though it was after failures and disappointments not a few. The colours then first reproduced, after Eastern examples, were what have since become universally known as the "Liberty" colours. It is claimed for them the credit of having revolutionised the whole colour scheme, as now applied to articles of dress and ladies' wearing apparel, in England, in America, and to a certain extent on the Continent of Europe. And as is



ARAB INTERIOR AND FITTINGS.

invariably the case with any successful idea, it has been largely imitated. If there be regret that the whole of this new trade does not pass through the hands which originated and embarked enterprise and capital in it, Mr. Liberty has satisfaction in the reflection, that it was through his personal instrumentality the extensive and beneficial revolution has taken place. And the "Liberty" colour process of manipulation alone still secures the most beautiful and least fugitive colouring, being thus still in advance of any other.

A steadily increasing business in the several departments continued to be made up to the year, 1882, when it became a most serious question how to find space to accommodate the trade, for no adjoining house could be obtained. It was ultimately solved by opening separate premises, at Chesham House, 142 and 144, Regent Street, and transferring thence all the departments which appertained to household decoration and furnishing, retaining at East India House the departments correlated to dress fabrics and personal adornment. At the new premises, a special studio was arranged for the study of Eastern architecture and Eastern interior decorations generally. The studio proved of the greatest use in maturing and producing designs for curtain hangings, stuff fabrics, muslins, carpets, &c., &c., and the style that has commended itself as most practicable for Western use, for furniture and fitments, viz., the "Arab."

In February, 1883, it was found desirable to develop a dressmaking department at East India House, and this wholly on account of the unsatisfactory manner in which the regular dressmakers "made up" and burlesqued the supple "Liberty" materials. For this department a second studio was started, under the auspices of a distinguished member of the Archæological Society. Lessons were given in drawing, and copies collected of the best forms of design for graceful dresses. This embraced all historical periods, and they were combined with the steady purpose to attain the practical, as adapted to nineteenth century needs. This branch, in fact, is an educational school for personal adornment, where forms, draperies, colours, and ornaments are studied, and the most beautiful types of modern dresses are produced. Moreover, artistic attention is given in the choice of colour of the various fabrics to suit all complexions and the various shades of hair.

Mr. Liberty also introduced the now celebrated Umritza cashmere, which combines all the individuality of a hand-woven fabric with durability and extreme softness of touch. And in introducing this idea of producing by means of machine-looms, a counterpart of this originally hand-woven fabric and by creating a demand for the material, Mr. Liberty was the direct means of stimulating the woollen and stuff manufacturers of England to themselves follow in the same lines with all descriptions of woollen and stuff materials, and on their own behalf. He has thus been directly instrumental, in most materially stimulating a home industry, wholly apart from his own business, that had for years languished and was passing into Continental hands.

A further extension of East India House was fortunately able to be carried out about Michaelmas, 1885. In the meantime, Chesham House departments had again further developed. In the spring of this year (1887) Mr. Lasenby Liberty added five houses to the block, more than doubling the area of Chesham House premises.

An auxiliary to the retail businesses, a wholesale trade, has grown up and been located at 2, Argyll Place. Here the "Liberty" materials are supplied to the "trade," and to special agencies in England, in America, and on the Continent of Europe. We anticipate that this departure may supersede in importance the whole of the extended retail businesses.

At the present time the business premises belonging to Mr. Lasenby Liberty, under the style of Liberty & Co., consist of "East India House," 218, 222, and 230, Regent Street; 42 and 43, King Street; "Chesham House," 140, 142, 144, 148, and 150, Regent Street; and 26, 27, 28, 29, 30, and 31, Warwick Street; "Wholesale House," 2, Argyll Place. The total staff of employés alone is increased to many hundreds, and the numbers, directly and indirectly, engaged in the production of the "Liberty" specialties must now be reckoned by thousands.

The extensions of the original business premises of Liberty & Co. alone will prove the success with which the efforts of this remarkable man have been crowned. He may well be proud of the world-wide fame of his Art Fabrics, with which the name of Liberty will for ever be associated.

Apart, however, from artistic considerations, Mr. Liberty has conferred great benefits upon large numbers by affording remunerative employment to thousands of hands. His vast establishments in Regent Street are among the great sights in the metropolis of the world. This is truly the home of æstheticism; and honour must be accorded to Mr. Liberty for having fought the great "Art" battle of the present age and fought it most successfully.

All who delight in artistic designs and colours should certainly inspect this great and interesting collection of Art Fabrics and Art Furniture, which are represented in all their branches. Truly may it be said, that the name of Liberty is now a household word, not only in this country, but also on the Continent, in the Colonies, and in the United States.

Messrs. Gillow & Co., London, Lancaster, Liverpool, and Manchester.

THE kinds of objects required for furniture have varied according to the changes of manners and customs, as well as with reference to the materials at the command of the workmen, in different climates and countries. There can be seen in the British Museum, ancient Egyptian chairs, workmen's tables, and sculptured representations of Assyrian seats, brought to light during the excavations of Nineveh. The vase-rooms of the British Museum and the Louvre give frequent illustrations of chairs, couches, &c., as well as of the stuffs used in upholstering them. Sumptuous Greek furniture during the last two centuries B.C. was made of bronze, damascened with gold and silver. The chairs, couches, and seats of the Romans were of similar shape to those of the Greeks. Their dining-tables were of wood, curiously veneered, to which a high value was often attached. They rested on tripods or frames of four or six legs, ornamented with figures, busts, animals, &c., in bronze. According to Pollen, the Romans changed their tables with each course. In the later ages of the Empire in Rome, and afterwards in Constantinople, gold and silver were plentiful for furniture; even cooking and common house vessels were occasionally made in those metals. The architectural features so prominent in much of the mediæval furniture begins in the Byzantine and late Roman thrones. These features become paramount as Pointed Architecture became general in Europe, and scarcely less so during the Renaissance. Most of the mediæval furniture, chests, seats, trays, &c., of Italian make were richly gilt and painted.

In Northern Europe, carved oak was more generally used. The splendour of most feudal houses depended on pictorial tapestries, which could be packed and carried from place to place. "The furniture of the Middle Ages," says Jacquemart, "must be divided under two different heads; the most important examples are evidently those for religious use. Were not the workmen established in monastic houses specially bound to devote all their energies to the adornment of the Church? History proves it; and the masterpieces of art must be sought amongst the stalls of the choirs and the ornaments of the sacristy."

At the threshold of the Renaissance, religious and secular furniture became assimilated. To discover the latter, we must necessarily search the manorial habitations. With the primitive carpenters who constructed chests and caskets, art was held naturally secondary in rank. Solidity, it may be well imagined, was the first qualification for these chests. The Parisian Museum possesses one of these coffers, iron-bound, on the same system, and, perhaps, by the same hand, as the celebrated entrance-doors of Notre Dame, one of the masterpieces of the thirteenth century.

From the close of the eleventh century, however, the necessity of embellishing with ornaments in relief, such objects as were constantly placed within sight, and which required to be in greater harmony with the splendour of hangings and dress, began to be understood; they even went farther, and broad surfaces were covered with gold grounds set off with paintings. In the following century, elegance of form began to be

considered, and wood turned with the lathe was introduced in the construction of furniture, and then in the thirteenth century the grounds were ornamented with sculptures in low relief.

The reign of Louis XIV. may be termed the triumph of gilded wood. Consoles covered with rare marbles or Florentine mosaics; tables with granite and porphyry slabs, were constructed with massive pillars, carved fronts on which suns, laurels, and different symbols stood out from grounds chequered in rosettes; cross stretchers in foliage were raised in volutes bearing elegant vases—the same arrangements are seen in the legs of the seats; vast arm-chairs with high backs and curved extended arms; immense couches covered with velvet and tapestries, with flowers and subjects, or silk figured in harmoniously-assorted colours.

"Under Louis XVI.," says Jacquemart, "the period of refinement of every description of wood was to enter on a new phase; not only its forms are sobered down by being covered with delicate details, but it carries coquetry to the extent of abandoning gold ornamentation, to show itself clothed with a simple coating of white paint, barely relieved, in some cases, by mouldings of pale lilac or sky blue." Nothing can be prettier than a little drawing-room in this style, in which the borders of the glasses, sometimes surmounted by an amorous trophy with its doves and torch, the console tables with white marble tops, furniture in pale figured satin, or in striped silk, with soft tints, have no other relief but the fine ornamented bronzes as delicate as jewellery, thus permitting the triumphant beauty and infinite elegance of the ladies who inhabited them and enlivened them by their animated grace to appear unrivalled. It must be admitted that this much-abused eighteenth century had in its latter days discovered the secret of the most refined taste and the highest degree of politeness and *bon ton*.

The system of veneering, or coating common wood with slices of rare and costly woods, fastened down with glue by screw-presses, made to fit the surface to be covered, came into general use in the eighteenth century. Marquetry is veneer of different woods forming a mosaic of pictorial or ornamental designs.

Mr. Edis, in one of the Cantor Lectures delivered before the Society of Arts, says:—"Since the latter days of the Renaissance, when the decadence and fall of all real art practically set in, there have been sundry fashions in architecture, painting, and decoration which have had a short and fitful life, giving way, like all fashions which are grounded on no love or real feeling, to the caprice and taste of the last new-comer. From the end of the sixteenth century we have gone through many phases, from Classic to Gothic and from Gothic to Queen Anne. We had for a long period an affectation of a Classic taste, when the decoration of Pompeii was imitated *ad unuseam*, but without understanding or knowledge of the principles of the art, the walls were overladen with heavy colouring and gilding; and in furniture comfort and utility were sacrificed to Classic forms. Then came the Gothic revival, and in furniture we exchanged the curule chair for the narrow seat and the knobby back, not more comfortable or pleasant to our persons than the ancient sedilia; and now has set in a fashion dedicated to her most sacred Majesty Queen Anne—a fashion which has developed much of really good art character, and which, after all, properly applied, is bringing us back to old English work."

No Firm in this country has done more in the cause of artistic design in decorative hangings and furniture than Messrs. Gillow, of Oxford Street, London. This house was first established at Lancaster, in the time of Charles II., and traded with the West Indies, from whence the Firm imported woods for the manufacture of furniture. Towards the latter part of the eighteenth century Messrs. Gillow opened an establishment in Oxford Road (now Oxford Street), London, and in 1839 they removed to their present fine premises, No. 406, Oxford Street.

The real revival of taste in respect to internal decoration came to this country in 1851, upon the establishment of the first Great International Exhibition. From that date Messrs. Gillow & Co. took a prominent position in the new movement. The reputation of this house has never declined,—on the contrary, it has been considerably enhanced of late years by the excellence of workmanship produced, and by the meritorious efforts of the present artistic director, Mr. Henry, who has done so much to train the British workman to something like the degree of excellence displayed by the Italian carvers and cabinet-makers. The mahogany and carved chairs of Chippendale and Sheraton are faithfully copied by Messrs. Gillow with something like the spirit of the originals. They devote great skill to the manufacture of tables and cabinets, the latter being noted for the perfect fitting of small interior drawers, &c. In their show-rooms may be seen cornices, brackets, and other projections, busts, figures, and carvings of the finest relief. It has been said that London cabinet-makers rarely attempt the figure in the carving of which the French and Italians have proved themselves such perfect masters. This statement now requires modification, for, since English workmen have been instructed in the fine details of the art of carving, Messrs. Gillow & Co. have been able to exhibit figures which, for sharpness and

exquisite delicacy of detail, will compare favourably with the works of the Italian masters. No expense is spared by this firm to advance British art. Occasional visits to Italy and Germany are made to collect fine specimens of carving, solely for the purpose of stimulating his English carvers to attain that degree of excellence necessary to satisfy the connoisseur. Large sums of money have been expended in this way, therefore it is no matter for surprise that Messrs. Gillow have earned a reputation in the art-world which is unique. In the Exhibitions of 1862, 1867, 1878, and 1883, they filled the position of honour, having been elected to provide fitting places of reception for Her Majesty the Queen and His Royal Highness the Prince of Wales in Paris and in London, while for their signal services in regard to the Royal Fisheries Exhibition they received a Gold Medal.

At Paris, in 1878, as one of the principals of the house held rank as a juror of the International Exhibition, it was not possible to present Messrs. Gillow & Co. with an award. The French Government, however, repaired this enforced omission by conferring on a member of the Firm the Cross of the Legion of Honour, while two of the artists were appointed officers of the Academy of Fine Arts.

DINING-ROOM AT THE PRINCE OF WALES'S PAVILION—PARIS EXHIBITION, 1878.

The Pavilion designed by Messrs. Gillow at the Paris Exhibition was a revelation to the French people, who had never before had an opportunity of judging the excellence of English decorative art. Referring to this splendid show of art furniture, Mr. Edis, in a Cantor Lecture, said:—"The exquisitely beautiful satin-wood furniture of Adam's style, exhibited in the boudoir of the Princess of Wales's Pavilion at Paris, by Messrs. Gillow, was, to my mind, an example of exceedingly delicate and graceful adaptation of eighteenth-century design to modern furniture. The panels of the various pieces formed in walnut-wood, with ebony inlaid, and laid over with boxwood carved down, so as to show the ebony behind, in exquisite cameo-like medallions after Flaxman; the delicate enrichments and ornamentation of gilt lacquer-like character, were all elegant in design and marvellously beautiful in workmanship. The walls of this charming little room were arranged in panels hung with blue figured satin divided by pilasters decorated in shades of blue and gold on maize-coloured silk, the general tone of the ceiling being ivory-colour, with the background of the enrichments slightly tinted in green. The satin-wood chairs and couch were covered with figured blue satin, and the floor with a carpet of rich Persian colouring on a maroon ground."

"Amidst numberless exhibits, all germane to the International Fisheries Exhibition, stood a building which was the cause of much interest and curiosity on the part of thousands of the visitors. The Royal Commissioners, recognising the great obligations due to his Royal Highness the Prince of Wales, who, as President, has never wearied in his efforts to promote the success of the undertaking, were desirous to provide an Official Residence suitable for his reception, similar to those furnished on previous occasions of public interest, and Messrs. Gillow & Co., in response to the request of the Commissioners, provided the internal decorations and equipments of a suite of rooms worthy the reception of an illustrious personage. The selection of Messrs. Gillow to accomplish this work was determined upon by the Royal Commissioners, as this Firm had in 1878 in Paris, as in London in 1867, employed the unrivalled resources of their great artistic and manufacturing organisation in the creation of Royal Pavilions which were objects of international admiration, and which proved that England held a place in respect to the beauty of decorative work and domestic requirements second to none in the world. This house sought, at the Fisheries Exhibition, to utilise to the best advantage a suite of rooms, which, though not large, have been invested with much artistic expression.

INTERNATIONAL HEALTH EXHIBITION—LONDON, 1884.

"The interior of the Pavilion may be briefly described as follows:—An Entrance Hall, with large and very attractive recesses on each side, in the style of the Flemish Renaissance, the walls having panels of tapestry with subjects of the chase from the Royal Windsor Works. On the left is the opening through a portière leading to the study, fitted in the style of the Italian Certosina, walnut inlaid with ivory, &c. The Dining Saloon, of massive walnut, is hung with gold Venetian tapestry, the coffered ceiling in wood having panels of bold ornament in blue and gold; the ceiling of the bay window is decorated with a figure of Venus rising from the sea. The furniture is of carved walnut of the Italian cinque-cento period, the seats covered with embossed velvets. A striking object in this apartment is the beautiful screen from the Royal Works, containing figures in tapestry of Joan of Arc, Cimabue, and St. Agnes. The boudoir of H.R.H. the Princess of Wales, adjoining, is in the 'Adam' style, with pilasters of maize-coloured silk, having enrichments in blue and gold. The furniture is of satin-wood, with floral decoration, amorini, &c. The doors, inlaid with various woods, have panels of cupids after Flaxman in *bois sur bois* cameos."

The principal manufactories of this house are in London and Lancaster, where more than 500 men are employed, with several steam-engines and machinery representing every modern improvement, having respect to economy with excellence and facility of production. There, also, are the great timber-yards, which cover an area of no less than six acres, the total extent of the premises being much greater than that of any other house devoted to a like business in the kingdom. The magnitude and importance of its operations may be inferred from the constant employment of so large a body of workmen, with a staff of highly-paid artists, in whose studios will be found work in progress in every style.

The name of Gillow is an absolute guarantee that nothing bearing it is of inferior quality, and the business organisation as to skilled labour and mechanical construction has brought economical production to the highest perfection.

In the archives of their house are recorded over two centuries the names of many of our most illustrious statesmen and great ruling families, amongst whom, in the present, may be found those of Her Majesty the Queen, His Royal Highness the Prince of Wales, His Royal Highness the late Duke of Albany, His Royal Highness the Duke of Connaught, and others not only of distinguished rank, but eminent in art, science, letters, law, divinity, the service of the State, and commerce.

INTERNATIONAL HEALTH EXHIBITION—LONDON, 1884.

Messrs. Elliott & Fry, London.

OF all the discoveries made in Science and Art during the reign of Her Most Gracious Majesty Queen Victoria, whose Jubilee we are this year celebrating, few have given so much pleasure to mankind as that of Photography. Just forty years ago, popular attention was directed to the influence of light upon certain chemicals, by the announcement in France of the inventions of Niepce and Daguerre, for the fixation of the images of the camera obscura, and, simultaneously in England, of that of Mr. Fox Talbot. In the former of these, the material employed was a metallic tablet of silver-plated copper; in the latter (that of Fox Talbot's), paper sensitised with nitrate of silver was used. With these discoveries, Photography may be said to owe its birth.

Many persons now living will remember the silhouette and the ivory-miniature, the only means half a century ago of perpetuating the lineaments of our grand-parents, and then after Daguerre and Talbot had succeeded in utilising the sun in their system of portraiture, though the result, for that period, was extremely successful, it was nothing to be compared to the present perfection of the art.

It was in the year 1863 that Messrs. Elliott & Fry opened their galleries at 55, Baker Street, London. As time went on, they found it necessary to take the adjoining house, No. 56, thus constituting, under one roof, the largest and most elaborately-fitted-up establishment of the kind in the United Kingdom.

The reception-rooms are arranged in the most artistic manner, the walls and other space being occupied not only by photographs taken direct from life, but by beautiful and artistically-finished specimens of the various processes for which Messrs. Elliott & Fry have a great reputation. The chief, and perhaps the most acceptable, is what is commonly known as the carbon process; the reason being that large and, if required, life-size portraits can be produced from daguerreotypes, faded or any other form of portrait (as well as from Elliott & Fry's own negatives), without losing the likeness, and, at the same time, finished in black and white, monochrome, water-colour, and oils. One room is taken up entirely with specimens of oil paintings (some life-size) with which great success has been achieved.

Another application of the carbon process is that on porcelain, in many cases it being preferred to paper, as a greater delicacy and softness can be obtained. There is one important advantage which should not be overlooked in regard to these portraits, and that is, their indisputable permanence. In one of the rooms there are some pretty specimens of carbon enlargements on paper and porcelain, resembling in colour and effect the famous Bartolozzi engravings. It need hardly be said how successful Messrs. Elliott & Fry are in the ordinary portraits in the various styles and sizes, much of their great reputation being undoubtedly due to the uniform excellence of their every-day portraiture. Messrs. Elliott & Fry are extensive producers and publishers of photographs of celebrities of every class—bishops, authors, poets, actors and actresses, politicians, as well as members of Royal Families being amongst their published photographs.

Last year Messrs. Elliott & Fry built, fitted up, and opened a branch establishment at 7, Gloucester Terrace, South Kensington, where they have every prospect of doing an extensive business; the rooms are simply though elegantly furnished, and all *en suite* on the ground floor. This is a special advantage, and one that is greatly appreciated, as the toil of ascending flights of stairs is avoided, as also the dangers and unpleasantness of a lift.

The Studio is fitted up with all the newest and most improved apparatus, and their accessories are chosen with a view to the composition of picturesque effects. Every effort is made to produce really high-class artistic work, and in their everyday portraiture to procure the very best results obtainable of each individual sitter. Messrs. Elliott & Fry study to make natural, simple, life-like pictures, true portraits, and characteristic likenesses, and to regulate the lighting and posing according to the principles of art. At Barnet they possess Model Printing Works, where not only do they print their own photographs, but produce enlargements of every size and description by the carbon, bromide, and platinotype processes.

Messrs. Elliott & Fry are also manufacturers of a commodity used in photography, viz., dry plates, which, besides being used in their own studios, are supplied in large quantities to the wholesale and export markets. It may here be mentioned that Messrs. Elliott & Fry's staff at their three establishments number nearly eighty, including artists, operators, printers, &c.

As time goes on, it seems as if Photography and Art were to become more welded together, which bids fair to make the former more than ever the most agreeable of any of the processes and inventions that this Jubilee period has seen brought to perfection.

Messrs. W. & A. C. Russell & Co., Scotia Foundry, Pendleton, near Manchester.

ARTISTIC ironfounding, as distinct from engineering and general ironfounding, has made such remarkable strides during the last fifty years, both in the methods of manufacture and towards more varied and universal application commercially, as to warrant its being specially noted as a marked feature, if not a tangible creation, of the Victorian age. Prior to that, the use of cast-iron in any other industry was exceedingly limited, except, perhaps, in the cases of machinery, artillery, and a few manufactures for domestic use. It is only within the last twenty-five years that excellence in ironfounders' goods has secured attention and just estimation, rendering it commercially practicable to separate artistic from what, for want of a better expression, we may call common or heavy, ironfounding, and to raise it into a distinct, self-sustaining branch of industry. There is now to be found a happy association of improved usefulness with elegance of form; the public taste in every direction has rapidly advanced, and no ironfounding Firm of any note (especially in the direction of art industry) can make headway in these competitive times without its staff of designers and artistic workmen. We venture to say that no ironfoundry in the world had, fifty years ago, for artistic purposes, so large a staff of art workers as has the subject of our present notice to-day.

We choose this Firm (Messrs. W. & A. C. Russell & Co., Manchester) not for its longevity as a Firm, nor for the vastness of its Works and trade, but because it is recognised as being representative of the energy, taste, enterprise, and skill of the ironfounders of modern times, in giving to cast-iron appropriate adornment and symmetry, and in adapting it to purposes hitherto overlooked; it is, in short, a suggestive type of the rise and progress of artistic ironfounding industry, which, with other kindred industries, so distinguish Her Majesty's reign, and play a very important part in the creation of the comfort and commerce of the times.

If anything more than another marks the Victorian age, it is the marvellous rapidity with which one advance is overshadowed by its follower—the growth of new industries and the decline of the old. Increased means of transport, change of processes, larger demands, increased skill and competition compel old-established businesses either to advance with the times or succumb; the old pace will not do; and it is such Firms as the one under notice that are found leading the race.

The Firm at first consisted of Messrs. William Russell and Alexander Cockburn Russell, but in 1881 their brother-in-law, Mr. Alexander Neil, became a partner. Mr. William Russell received his early training in the Falkirk Iron Works, Stirlingshire, Scotland, a foundry of long standing, and an offshoot of the venerable Carron Iron Works, in the same district, which latter has the honour of being the parent iron-foundry of Scotland, and still sustains a world-wide reputation. Beginning work before his eleventh year, he served his apprenticeship to artistic pattern-making, and spent eleven years with the Firm. The variety and quality of their manufactures gave opportunities to an observant student of acquiring a general utilitarian grasp of the ironfounder's

art. He was then appointed foreman pattern-maker at Maryhill Iron Works, Glasgow (at which Works, curiously enough, his father had sixteen years previously, at the time of his death, been foreman grate-fitter). Having a desire to experience the initiatory tradesmanship involved in the first start of a new foundry, he secured the leading place as pattern-maker to the Grahamston Iron Company, Falkirk, and there felt the full weight of initiating work from its very beginning. Soon after he entered the service of his uncle, Mr. Cockburn, of Gowan Bank Iron Works, in the same town, assisting him first as foreman pattern-maker, and then as sub-manager of the Works. Here his bias for design and improvement of the constructive character of iron goods had fuller play. Among other important branches of work for which Mr. Cockburn had acquired eminence, was the making of gas-stoves and sewing-machine castings. Partly owing to his experience in connexion with such, and partly from a desire (common to young, self-reliant Scotch artisans) to try his luck among strangers, he was appointed to the charge of the iron-foundry of the Pendleton Sewing-machine Company, Limited—which was projected by a group of manufacturers to turn out a new sewing-machine on a very extensive scale. This Firm, from legal causes, collapsed a few months after formation; and on January 1, 1876, Mr. W. Russell had to consider what must be his future.

Never dreaming of becoming an employer previously, the circumstances by which he was surrounded compelled him to seriously consider the question, with the result that a partnership was immediately formed with his brother, then assistant-manager to Mr. Cockburn, in Falkirk, with whom (following the same trade as his elder brother) Mr. A. C. Russell had received the bulk of his training; he had, for a short interval, been in the employment of that eminent architectural iron-foundry Firm—Messrs. Walter Macfarlane & Co.

Commencing under many difficulties, the brothers set to work in an unpretentious but determined way

PENDLETON. LONDON.

to erect the Scotia Foundry, and initiate a new trade in the district of Pendleton. On April 13 (fully three months after the sudden stoppage of the Limited Company), the first iron was melted, and their first casting made from a pattern park chair arm, specially designed by them, and which that same week gained for them, in a public competition against established Firms, their first order of 250 park seats.

At the time they started, the ironmongers of Manchester doubted the practicability of casting artistic light castings in or near Manchester. Nothing in the mantelpiece and stove grate line had previously been made in Lancashire, except stray items here and there. Pendleton castings are now to be found almost everywhere. Undoubtedly the Scotia was the first successful pioneer in the county of the present artistic casting trade, and still leads the van, unchallenged in design, finish and *bona fide* value.

Mr. Neil, on entering the Firm, brought with him a ripened technical business experience, having been for many years manager to a well-known Firm of Clyde shipbuilders, and, previously to that, head foreman to that world-famed Firm, Messrs. John Elder & Co., Glasgow, growing into that honourable position through all the grades from an apprentice ship-carpenter. With this accession to the partnership the Firm felt free to still further extend their business relations with the public; and, in due time, in addition to still further increasing the chief Works at Pendleton, they established a branch Works and depôt in London, so as to more conveniently manage the general business of the Firm in this country and the colonies.

A brief description of Messrs. Russell & Co.'s Works will better indicate the leading features of their extensive business. The frontage of the Pendleton Foundry consists at present of a number of low buildings; in their place it is intended to erect large and commodious premises which will be arranged for offices, show-rooms, and despatch departments. Skirting the side boundaries the finishing departments will be

found, and in the centre a large group of buildings containing the moulding-floor, furnaces, and engine-room. On entering the temporary show-room, the stranger is at once struck with surprise to see so many varlously-coloured and highly-finished goods, picturesquely demonstrating the fallacy of the hitherto common opinion that an iron-foundry is the region of darkened intellect and low caste. We do not stop to discuss the reason for this false estimate of the artisan; we are satisfied that the great ones of the earth, the geniuses in mind and handicraft, the intelligent and pure, are not confined to the Upper Ten, and that under many a work-begrimed face are to be found great and good men, benefactors of mankind.

A glance round this show-room shows, even to professional ironfounders of long standing, that the Messrs. Russell are leading the very front rank. Here we see a distinctive series of originally-designed artistic iron mantelpieces, with overmantels, mirrors, and fire-grates to suit, such as were quite unknown fifty years ago. The attractiveness and merit of these lie partly in the bold originality of their symmetrical configuration and graceful purity of design, partly in their useful construction and strength, but chiefly in their unrivalled finish and harmoniously - coloured enamelling; we say, unrivalled, because, while Messrs. Russell & Co. were the first to lead the way successfully in the artistic enamelling of iron mantelpieces and similar goods, they are as yet unapproached by any makers, and are generally acknowledged by the trade to be unrivalled in that branch of their business.

VICTORIA (JUBILEE) CAST-IRON MANTEL AND OVERMANTEL.

The newest of their mantel designs (see opposite page) is a fine specimen of bold, pure design, and, when to this is added the brilliant finish and colours, such as cream, pink, and gold, or imitations of oak and walnut and gold, or variegated-coloured electro-bronze, the effect is superb; and there need be no hesitation in stating that this mantel and overmantel is the most perfect specimen of casting ever offered to the public.

The other branches in which this Firm excel are highly-finished, useful coal and gas-cooking ranges and gas-stoves, they having for many years given the subject of gas-cooking and warming their special study. We only mention two distinctive examples, namely, their combination gas and coal ranges, one class being designed to meet the wish to cook with the same ovens, &c., with gas or coal at will, either separately or both at the same time. A most effective series of patented inventions, novel yet simple, stamp this as the most original of modern cooking coal fire and gas ranges; for, prior to this, no Firm ever established the practicability of using the same oven for coal or for gas at the same time. This range, we feel sure, has an important future before it. The second example keeps separate the two methods of cooking within the same fire opening.

Each department is under the charge of specially-trained foremen, and evident mutual confidence and friendship exist between employers and employed, assuring the steady progress and success of the Scotia Foundry. The first departments, viz., the pattern-making and designing-rooms, indicate at once the originality of the enterprise. Here a staff of select skilled designers and workmen — over twenty in number — are engaged solely on the making of patterns in wax, plaster-of-paris, composite, metal, and iron. Here we see delicate ornament and parts of constructive work fashioned with nicety and care; and heavy expenses are incurred, which only a vast turnover of castings could recoup. From this we pass to the extensive moulding-shops, where the standard iron patterns are in full work, and the floor, consequently, completely covered with moulds every day in the year, except holidays. The casting operation is, to a stranger, generally the most interesting; the massive furnace, the din of the pressure blast-engines, the liquid iron shooting forth, in a fountain-like stream, into the ladles, deftly carried off, when full, to fill the various moulds. The castings are removed during the still hours of night, to the dressing-shop, where the loose sand is removed. From this department the goods pass on to the inspector's room, whence those that are passed go for finishing to the fitting or filing-up shops, where the castings are carefully worked up to a still more perfect state; and then to the polishing-mills, where numerous grindstones and wheels are used to grind and polish up the surfaces as required. From the grinders they pass on to the finishing department, where the brasses are also burnished; and from this, yet again, to the decorating and enamelling-rooms, where the goods have to go through further stages before completion. The decorators neatly cover the surfaces with such designs or patterns as the orders require,—every description of imitation marble, spar, granite, or of woods, such as oak, walnut, rosewood, &c.; these, in their turn, shaded and picked out in colours or gold. Besides these imitations (which, in the opinion of some, are considered false art, but which, nevertheless, give pleasure to and suit the tastes of many others), the goods are here enriched with natural colours, in various tints and arrangements, from the heavy tones to suit the dining-room to the lighter ones for drawing-room and boudoir. Again, we see them finishing hand-painted panels with flowers and landscapes, by which the mantels are adorned. Here, also, the process of bronzing is done; but where special electro-deposit bronzing is to form part of the decoration, it is sent on to the most recently added branch of their business,—the electro-plating room, where a series of baths, electric machines, and finishing tools are used to cover the face of the goods with silver, brass, or bronzes of varying hue.

The imitations and finishes are so perfect that the most observant seeing them for the first time are deceived; and when informed pronounce them so pleasing as to make it a common opinion that the imitations are more satisfying to the eye than many of the real woods and marbles would be. Of course, real wood and marble have the merit of being what they seem; but it is very frequently the case that mantelpieces of costly marble, &c., are made up out of materials most disagreeable to look upon; and it becomes a question, Which does the most good to mankind? a clumsy and ugly job in real marble and timber, which gives no pleasure to the eye and less comfort generally, or an imitation, in equally useful materials, well done and cheap, which gratifies the eye by its beauty.

In a recent address Mr. W. Russell expressed in a few words what seems to us to be the key-note to success in such a line of business:—"Success in any trade," said he, "could not come from clinging to old ideas, either in prices, tradesmanship, or goods; but from fresh thought, added to former experience, centering on the problem how to make goods of the greatest use, with the most grace, at the cheapest price, and how to sell such with small profits to create the masses into buyers. Competition so guided must spread good broadcast, and tend towards perfection and happiness."

United Asbestos Company, Limited, London.

THE name of this interesting material—Asbestos—is derived from a Greek word denoting indestructible by fire. The ancients seem to have been well acquainted with its fire-resisting properties. In the history of his adventures amongst the Chinese, in the latter half of the 13th century, Marco Polo mentions having seen a cloth which resisted fire, and was said to be made from the skin of the salamander. He states, however, that on examination he found it was made from a fibrous mineral called "Amianto," *i.e.*, Asbestos.

There are also preserved in the Museum of the Vatican, Rome, and in that of Naples, napkins made of this material, which the emperors, to astonish their visitors, are said to have thrown on the fire. There are others, however, who assert that these cloths were used for preserving the ashes of the bodies from contact with the ashes of the fire in the act of cremation. Although the valuable properties of Asbestos were thus known to the ancients, it is only within a comparatively recent period that they have been turned to practical account for engineering and other purposes.

About 1870 an Italian priest, by name Giuseppe della Corona, of Florence, succeeded in manufacturing a millboard made of Asbestos, and its valuable properties as a jointing material for engineers were soon recognised. In 1872 a Company, the Patent Asbestos Manufacture Company, Limited, was formed at Glasgow for manufacturing Asbestos into engine packings, jointings, &c., and was very successful. This Company, to which belongs the honour of having first established this industry in our country, was, in 1880, amalgamated with other two Companies, thus forming the United Asbestos Company, Limited, of Queen Victoria Street, of which Sir James Allport, of the Midland Railway, is chairman.

Asbestos is found in the serpentine formation all over the globe, but hitherto it is only in Italy and in Canada that a quality suitable for manufacturing purposes has been procured. In the former country, in which it was first discovered, it is found in the Val Malenco, nearly due south of the Pitz Bernina, and in the Valley of Aosta, and is of a long, strong fibre, frequently in pieces six feet in length. It is rarely found below 5,000 feet above sea level, and extends from this up to the line of perpetual snow. To obtain one ton of Asbestos twenty or thirty tons of rock have to be blasted by dynamite. In the Valley of Susa, near Mount Cenis, is found the white silky fibre used for gas-stoves made by Fletcher, of Warrington, and others. In Canada it exists in a belt of country extending from Port Levis, nearly opposite Quebec, to Sherborne, and in close proximity to the line of the Quebec Central Railway. It is a short, cottony fibre, and not at all equal to the Italian for strength.

Although so recently introduced to public notice, the applications of Asbestos are very numerous, and are every day extending. To the engineer, whether in the form of millboard, or proofed cloth, or putty, it furnishes a jointing material which is thoroughly reliable, even with the very high-pressure steam now employed

on the locomotive or the marine engine. Spun into thread, it is plaited or woven into packing for the piston valve, and other rods of steam engines; and when it is reduced to the consistency of stiff mortar it makes a very valuable covering for the boilers which generate the steam, as, whilst its non-conducting properties prevent the radiation of heat, its fire-resisting properties prevent its being destroyed by the heat to which it is subjected. To the iron and steel manufacturer this non-conducting and fire-resisting property makes it invaluable for lining the tubes that convey the hot air from the stoves to the furnace or cupola, and for the miner it forms the only thoroughly reliable joint for the cover of the safety lamp. For the builder, Asbestos supplies a material which, made into millboard or felt, is nailed to the underside of the joists, and thus prevents the spread of fire; but it is in the form of paint that its invaluable properties for the prevention of the spread of fire are to be seen. With this paint, supplied by the United Asbestos Company, all the wooden buildings used for the various exhibitions held at South Kensington were coated, and we have it on the authority of Sir Frederick Bramwell, C.E., F.R.S., that this paint was, in 1884, the means of preventing a fire, which had broken out in an exhibitor's stall, from spreading and probably involving the entire destruction of the buildings. It has also been applied, we understand, to the Houses of Parliament. Asbestos cloth curtains have also been supplied to many theatres, and have been fitted so that, in the event of fire breaking out on the stage,

SPECIMEN OF RAW ITALIAN ASBESTOS.
Size, 48 in. by 36 in. Weight, 45 lb.

ASBESTOS WORKS, HAREFIELD MILLS, NEAR LONDON.

the curtain can be lowered, thus isolating the stage from the body of the theatre. It is also spun and twisted into ropes and ladders for fire-escapes, and many now sleep more securely for knowing that in the event of fire they have a means of escape which the fire cannot consume.

For filtration purposes, the uses of Asbestos are well nigh innumerable. Woven into a close, fine cloth it is used by the beetroot-sugar refiner for filtering the saccharine juices. The same kind of cloth is used by the chemical manufacturer for filtering acids and alkalis; and Asbestos, either in this form of cloth or of finely-carded fibre, is used in all the most approved water filters of the present day. It is also used for the filtration of sewage, and in connexion with sewer-traps, in which it is saturated with deodorising liquids, which render harmless the escaping gases.

For the electrician, Asbestos tubes serve for the conductors of electric light installations; Asbestos paper for wrapping battery plates in; and Asbestos gloves enable him, with comparative impunity, to handle wires charged with the electric current.

Asbestos in the form of powder is also largely used for lining the spaces between the inner and outer boarding of wooden houses, and is equally effective in preventing the passage of the summer's heat or winter's cold. We have heard of an iron floating Bethel in the Port of Genoa, in which a lining of this material between the outer skin of iron and the inner lining of wood keeps the chapel so cool in summer, despite the intense heat of the sun, that visitors are astonished at the great difference between the temperature inside and outside the chapel.

Whilst Asbestos thus plays so important a part in the arts of Peace and Industry, it is also largely used in the art of War. For the huge breach-loading guns of the present day a pad made of a special quality of Asbestos fibre effectually prevents the escape of gas at the breech; and in the deadly torpedo, Asbestos also plays its part.

Messrs. Thomas Harris & Sons, Calne.

SITUATED on the main road from Marlborough to Chippenham, some half-dozen miles from the latter, the ancient parliamentary borough of Calne stands in the heart of a fine district, admirably suited for the support of such industries as depend directly on agricultural or pastoral pursuits. Although not boasting of a large population, the town is one of the oldest in Wiltshire, and many are the historic associations which give the antiquary an interest in the place. Formerly, this municipal and parliamentary borough possessed the privilege of returning two members to the House of Commons; but, since the Reform Act of 1832, it has never returned more than one; and since 1885 its parliamentary representation has been merged in that of the Chippenham division of the county. Several distinguished statesmen have sat for Calne during the present century, including Lord Shelburne, afterwards third Marquis of Lansdowne, Lord Macaulay, and, more recently, Lord Sherbrooke, better known as the Right Hon. Robert Lowe.

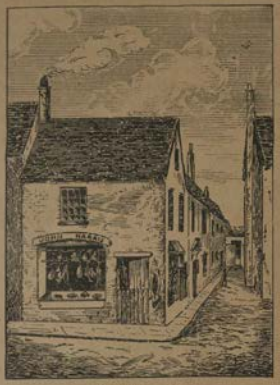
As for the town itself, it is well built, clean, and healthy, with a complete system of drainage, and a water-supply drawn from the neighbouring chalk hills. No town of the same size in the west of England can show finer municipal buildings than those which were here erected not long since; nor is the surrounding country entirely without handsome edifices; the charming residence of the Marquis of Lansdowne, known as Bowood, is situated in the near neighbourhood.

Half a century or more ago, the manufacture of cloth was carried on at Calne on a considerable scale; but this industry has now altogether disappeared, and others have taken its place. The principal industry is the curing of bacon, for which the place has obtained a great name. Indeed, Calne is now the chief seat of the bacon-curing industry in England.

Near the beginning of the present century, the business was introduced into the place by Mr. John Harris, who commenced work in the year 1805. This gentleman's son, Mr. Thomas Harris, who, in 1850, succeeded to the business which his father had founded, is now the senior partner in the well-known Firm whose name stands at the head of this article; and under his personal care and able management the original business has grown to its present large dimensions. His three sons, Messrs. J. M. Harris, Tom Harris, and Henry G. Harris, were admitted into partnership on July 1, 1885; and from that date the style of the Firm has been Thomas Harris & Sons, as above.

The very extensive premises in which Messrs. Thomas Harris & Sons' business is conducted are well designed and well constructed throughout; they are lofty, well-ventilated buildings, plentifully supplied with water, and fitted with every modern appliance for economising labour and ensuring safety. Two hydraulic lifts connect the different floors of the establishment, and fire-hydrants have been carried throughout the buildings; there is also a powerful manual fire-engine kept on the premises, and a fire brigade has been formed among the

workmen. When the electric light is introduced, as it is likely to be, the air in the buildings will be even purer, if possible, than it is already. Steam-power is supplied to the machinery by two large boilers.

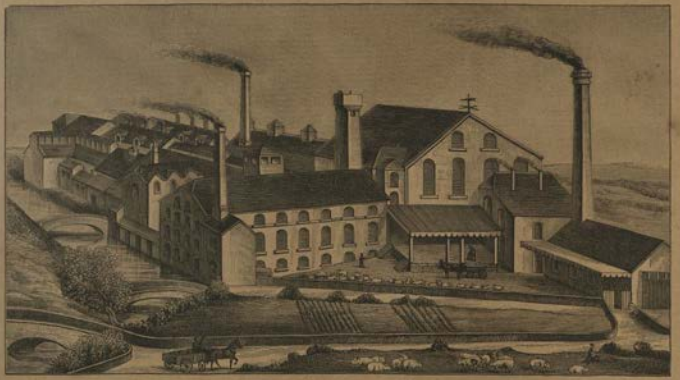


JOHN HARRIS, 1805.

About a dozen rooms are devoted to the smoking of the bacon, and as the smoking process occupies a considerable time these are kept constantly filled. Numerous cellars of large dimensions have been constructed, in which the bacon is kept in salt before being smoked. An excellent institution in the factory is the reading-room, which is well supplied with books and daily papers for the benefit of the employés. Of the other portions of the vast establishment, we may mention in particular the large room devoted to sausage-making, and the styes, in which as many as four or five hundred pigs, all of picked quality, are frequently kept ready to be killed.

Immense improvements have been made of late in the system of bacon-curing, as in well-nigh every other branch of manufacture. As the operation has to be conducted in a cool atmosphere, the old plan was to cure the bacon during winter, and to keep it hard salted for summer use. But this method was not altogether satisfactory, since the food so preserved was unpalatable and unwholesome. Consequently, various attempts were made to introduce some improvement into the system of curing that should render it possible to cure the meat in summer. One plan tried was to cut the skin and force salt through the incisions; another was to inject brine by means of a force-pump. But none of these attempts proved more than very moderately successful.

The development of the present system, under which the process is conducted on scientific principles, has been quite gradual, and has occupied many years. Much



THOMAS HARRIS AND SONS, 1887.

thought, also, and many experiments have been necessary before the system could be brought to perfection; but now that it has been perfected, a great boon has been conferred on that section of the public

with whom bacon is a customary article of diet. The essential difference between the old system and the new consists in the adoption, in the new system, of artificial means for reducing the temperature of the curing-rooms when the natural heat of the atmosphere is too great. By producing a winter temperature in summer the old difficulties are overcome, and mild-cured bacon can be made during the hottest days of July. The original plan for keeping the curing-rooms cool was to employ natural ice, which was stored on iron floors in huge chambers above the curing-rooms, the ice chambers being protected by non-conducting walls. To Mr. Thomas Harris belongs the credit of having erected, in 1856, the first ice-house in England on this principle; it was a small, experimental one, but its construction was subsequently improved; and eventually, in 1864, Mr. Harris obtained a patent for it. His system proved a decided success, and was adopted under licence by all the leading bacon-curers in Great Britain and Ireland. As a result of the introduction of this new method, a considerable demand for ice sprang

MR. THOMAS HARRIS.

up at Calne, and large quantities were collected in winter from the canal and other waters in the neighbourhood. When the winter was severe, the ice harvest furnished employment for the numerous hands thrown out of work by the frost; when the winter was mild, the bulk of the ice was imported from Norway. But although the ice-house plan answered well, and insured an even temperature during the process of curing, it has now been superseded in the establishment of Messrs. Thomas Harris & Sons by the more approved method of reducing temperature with refrigerating machinery. This latest innovation, however, has brought with it no change in the actual system of curing the bacon, which remains precisely the same as when the ice-houses were in use. By means of the refrigerating machines a constant temperature of about forty degrees is maintained in the curing-rooms, although the temperature of the air outside may rise to a hundred and twenty degrees, as it sometimes does in the summer.

About a thousand pigs a week are killed on an average at the factory of Messrs. Thomas Harris & Sons. Each carcase is passed, by a machine invented for the purpose, into a furnace to be singed; the moment this is accomplished the machine is turned round, the carcase deposited on a block ready to receive it, and a fresh one placed by the same machine in the furnace. When the singeing process is over, the carcases are removed to another part of the premises, and there cleaned and dressed. After hanging for a day, the sides are taken

to the curing-rooms, each carcase, however, being inspected by a member of the Firm, only the very finest sides being branded with their name. The large room devoted to sausage-making is fitted up with special machinery for the purpose, and only meat of the very best quality is there used. Ever since the days of the Romans, among whom the sausages of Lucania bore a great reputation, this method of preparing the flesh of swine has been much in favour; and the attention which is given by Messrs. Thomas Harris & Sons to this department of their business is enough to show that the popularity of the ancient dish is not as yet on the wane.

There is no waste permitted in the factory: every part of the pig is usefully applied to some purpose or other. The bacon, however, is by far the most important product.

Another highly-important article, which the factory turns out in large quantities, is lard, a commodity for which there is always a great demand. Ingenious machinery is in use for manufacturing this article, which is turned out absolutely pure, without any admixture of any kind whatever. The fat is first subjected to the process of pulping, after which it is conveyed—by machinery, without once being handled—to the boilers, and there melted down. Machinery also performs the work of stirring while the fat is being melted. Before being allowed to cool, the lard is strained three times; it is then placed in bladders specially prepared to receive it and each one stamped with the name of the Firm. An Otto gas-engine is used to supply the motive power to the machinery employed in the process of lard-rendering.

In the early days of Messrs. Thomas Harris & Sons' business there was, of course, no railway at Calne, and the goods were despatched to London by road—a long and tedious journey. When the Great Western Railway Company's main line was opened, passing through Chippenham, railway facilities were brought within six miles of the town; this, however, was not near enough, as the requirements of the bacon trade, for carriage of both pigs and bacon, rendered it most important that the town should be placed in direct railway communication with all parts of the country. The demands of the bacon industry led to the building of a branch line from Chippenham to Calne, in 1863; and, at the present time, many tons of goods are despatched by rail daily from Messrs. Harris & Sons' factory alone. The bacon manufactured by this Firm is supplied, through their agents, to the households of Her Majesty and H.R.H. the Prince of Wales, the Houses of Parliament, &c. &c., and is not only sent throughout England, Scotland, and Ireland, but finds its way to the continent of Europe, and, indeed, to the most distant parts of the globe, including India, China, the Cape of Good Hope, New Zealand, and numerous other distant places. For keeping in hot climates, the bacon is extra-cured and smoked. Although not, strictly speaking, the most nutritive of meats, the flesh of the hog forms a very large proportion of the animal food of most nations, and possesses qualities which make it in some respects a more convenient form of food than the flesh of other animals. It is more easily preserved by salting and drying than any other meat; and its use is often recommended in hot climates on account of the ease with which it can be kept, and in cold ones on account of the heat-giving properties which it derives from the large amount of fat in its composition. The modern developments in the mode of its preservation of which we have been treating have also rendered it one of the most palatable adjuncts to the breakfast-table.

A great extension of trade immediately followed the introduction of the ice system of curing bacon into Calne; nor was the extension merely the result of a temporary stimulus, to be shortly followed by a complementary state of relaxation. The growth of trade which was consequent upon the establishment of this new industry has been permanent. As might easily have been predicted, the development of the Calne bacon trade has proved of considerable benefit to the dairy farmers of Wiltshire and the surrounding counties. They have now a good market close by for their pigs; and, since the introduction of the ice system, the market is open to them throughout the summer as well as the winter. During the summer months the bye products of the dairy—whey and buttermilk—constitute a principal part of the food of pigs; and the farmers are thus enabled to turn to good account what would otherwise be almost valueless. Dairy products not only greatly assist the growth and fattening of pigs, but, at the same time, improve the quality of the meat.

Wiltshire has long been famous for its hogs and its bacon; and the district of which that county is the centre still produces the finest quality of hogs in the world. Careful attention is now being paid there—as, indeed, it long has been—not only to the feeding of pigs, but to the selection of the best class of animals for converting into bacon. This careful attention to what is really the essential point in the economy of the stock farm—namely, the improvement of the breed—is one of the chief of the causes resulting in the high estimation in which Wiltshire bacon is held; and, next to their own personal care and ability, this must be set down as one of the very first of the conditions which have rendered it possible for Messrs. Thomas Harris & Sons to achieve so great a success in their particular line of business.

The Gandy Belt Manufacturing Co., Limited.

IT would be difficult to point to any inventions which have conferred greater benefits upon users of machinery, or which have seen more remarkable developments, than those with which the name of Mr. Maurice Gandy is so prominently connected. He has practically called into existence a new industry, which, though at present assuming large proportions, is evidently only in its infancy. If, as has been truly said, "He who makes two blades of grass to grow where only one grew before is a benefactor of mankind," surely the inventor who gives to machinery-users a driving-belt which is in all respects superior to anything hitherto existing, and at about half the cost, deserves some recognition as one of that great band of inventors who have made the past fifty years remarkable in the annals of our country.

Mr. Maurice Gandy was born at Dibden, Hants, August 10, 1829. According to the parish records, his forefathers had been farmers there for over 150 years, and the subject of this notice was the first of a long line of farmers to develop new ideas. The published letters of the first Earl of Malmesbury show the intimacy existing at that time between his family and that of the Gandys, from whom the present Mr. Maurice Gandy is descended.

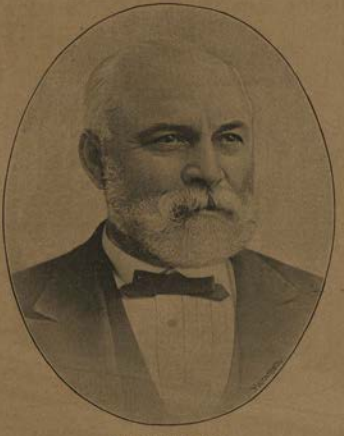
When quite an infant, he was taken to reside with the sister of his mother, wife of Mr. Hood, a farmer at Godshill, in the parish of Fordingbridge, Hants, where he was educated with a view to his succeeding his uncle in the farming business, but he early showed his disinclination for that life. As a boy he exhibited a taste for mechanics, but his youthful ambition having been fired by reading books of voyages and travels, he determined to adopt the sea as his profession. None of his friends favoured the idea, nor would they assist him in carrying it out, as their wish was that he should succeed his uncle, Hood, as a farmer. However, he was not to be deterred, and applied for assistance to an old friend of the family, Captain Sainthill, who pointed out to him that if he wished to become, as he expressed it, a captain of an East Indiaman, he must make himself a thorough seaman, which he would best do in the coasting brigs sailing out of the North of England, at the same time pointing out to him the hardships to be endured in that trade. This did not daunt the boy, and he left the farm and served his apprenticeship in the coasting trade between Sunderland and London. When out of his time, in 1848, he devoted himself to the study of navigation, and rapidly rose in his profession, until he was appointed chief officer in the far-famed clipper ship *Lightning*, which position he resigned in 1855, to take command of a barque to the Brazils. This he held for one year, and then went up for the extra examination in all the higher branches of navigation and nautical astronomy. Having obtained this certificate, the highest given, he achieved the object of his boyish ambition, namely, the command of an East Indiaman. While on a voyage from Bombay, in 1862, he was instrumental in saving the lives of a portion of the crew of the ship *Asia*, for which he was presented with a handsome sextant by the owners of that ship. In 1864 he retired from the sea and commenced business as a shipowner, and, in addition thereto, he became the agent for

his old friends at Fordingbridge, Messrs. Samuel Thompson & Co., sail-cloth manufacturers. His intercourse with this Firm revived his long-dormant mechanical turn of mind, and decided him to give up shipowning altogether and devote himself to some mechanical pursuit. While visiting some mills in 1873, he conceived the idea of improving the belting used to transmit power, and for the next four years he was constantly experimenting, with the idea of producing a driving-belt which should be free from the defects of the leather and india-rubber belts already in use. One of the chief difficulties in producing a good leather driving-belt is the impossibility of getting a number of hides which are exactly the same strength; and, when they are sewn together into one length, the inequalities soon show themselves, in spite of the tanning and stretching which they have previously undergone. The effects of damp, heat, and extreme atmospheric influences on leather are well known, and with a view of getting rid of these defects many attempts have been made to produce a substitute, the most successful of which was the combination of cotton cloth and india-rubber known to the

THE "GANDY" BELTING.

mechanical world as "Rubber Belting." This, though in some respects superior to leather, was not without its own defects, and for many situations it was a conspicuous failure. The outcome of Mr. Gandy's costly experiments and years of patient study was the belting known so well as the "Gandy Belt," and which to-day is recognised as the best belt yet produced for driving machinery. It is made of American cotton duck, hard woven to prevent stretching, then folded into the required width, the plies sewn together under extreme tension; then the belt is thoroughly saturated with oil, which not only softens the otherwise too-hard cloth, and makes it work easily round the pulleys without cracking, but it preserves it against atmospheric changes, and also imparts to it the necessary gripping power to cause it to adhere well to the pulleys. It was at first produced by hand, but the demand which sprang up immediately necessitated a quicker form of production, and then came the task of inventing special machinery for this purpose. This brought into play Mr. Gandy's inventive powers. First came the elaborate machinery by which the cloth is folded into the required width ready for stitching; then the machines to take out stretch and render the belt practically non-elastic; the machinery by which the belt was held under firm tension while being stretched; the machinery to facilitate the proper stitching of the belts, so as to ensure every stitch bearing the same strain when the belt is working; and

a further process of heating the belts whilst stretching, so that they may be rendered, as far as possible, stretchless when at work. Nine patents have been taken, giving these inventions in their finished and complete form; but those patents give the reader a very inadequate idea of the incessant labour it cost the inventor to produce and perfect them. Mr. Gandy has suffered the not uncommon fate of inventors. As soon as the success of the "Gandy Belt" was established it was at once imitated by a host of pirates. This led to legal proceedings, and in 1883 the patent for his Belt was declared bad, by reason of insufficient description. That has, however, been rectified under the new Patent Law. Mr. Gandy's incessant labour has had its reward in the appreciation of the value of his belting by machinery users all over the world. It may safely be said that wherever machinery is used to any extent, in any part of the globe, there the "Gandy Belt" is known. It has been exhibited at every leading Exhibition during the past ten years, and in every competition it has taken first place, and twenty-six prizes have been awarded for excellence.



MR. MAURICE GANDY.

Mr. Gandy's inventions have not been confined to belting and the machinery to produce it: he has invented, among other things, a method of grinding wheat by paper rollers; paper wheels of railway carriages, which are the best and safest wheels in the world, and though the railway companies in this country will not adopt them, they are highly esteemed in the United States. He has invented new wrappers for pressing oil-cakes, and has also invented an improvement in sewing-machines, whereby the shuttle is made to take hold of the loop and then wait until the needle has risen clear of the work. This forms a great safeguard against the thread breaking when sewing over the seams, which in ordinary machines is constantly occurring. He has also invented, and is now at work perfecting and patenting, belting made of paper, which he hopes shortly to lay before the world as something entirely new in machine work. Thus this farmer's son, reared on the borders of the New Forest, through untiring energy and perseverance rose to the highest honours in his profession at sea, and, retiring from that, has devoted himself to inventing means whereby users of machinery are greatly benefited, and will, therefore, by his inventions leave the world better than he found it. Of his many inventions, his pride is the "Gandy Belt." To this he gives his never-tiring attention, and all his energies are devoted to its improvement.

Sir Henry Bessemer.

IMPORTANT inventions, as a rule, are not produced in their perfected form by the cogitations of a single brain. In respect of their gradual development they may fairly be likened to great institutions; for they are not suddenly brought into existence, fully developed, at the will of an individual: they grow. Such has been the case with nearly every useful machine invented, or process discovered, which has materially aided in producing our present state of civilisation. A happy thought strikes one man, and another man forthwith endeavours to apply it; a third and a fourth improve on the original idea; and a fifth, or a sixth, or it may be a hundredth, brings it to a state bordering on perfection. But though this is unquestionably the rule, an exception has to be made in favour of the grand discovery and invention with which the name at the head of this article will for ever be associated. To Sir Henry Bessemer belongs the credit of having discovered a process, and invented machinery, by means of which the transition from the iron age to the age of steel has already, in less than a third of a century, been to a great extent effected. In scarcely any respect have his ideas been improved on by others: his invention is entirely his own. And our ALBUM would be very incomplete without a notice of the man who has done such great things for commerce and manufacture, and who holds an undisputed position at the head of the Steel Trade.

Unless the parents of an illustrious man have themselves been illustrious, it is a mistake on the part of a biographer to go into details concerning them. But, considering the talents and accomplishments of Mr. Anthony Bessemer, the father of Sir Henry, it would not be doing justice to his memory to pass him by without mention. This gentleman, though of English nationality, was for a long time resident on the Continent, where he distinguished himself, at the early age of twenty, by erecting the first floating steam-engine for draining the turf-pits near Haarlem. Migrating to Paris, he devoted himself to improving the microscope, and in consequence of his success received the distinction of being elected, while still quite young, a member of the Academy of Sciences. When the French Revolution reached its climax in 1792, he was holding a post in the French Mint; but, on the accession of Robespierre to supreme power, he was given the management of a public bakery instead. Subsequently, however, he was thrown into prison; but, succeeding in escaping, he made his way through the greatest perils to England. Here he had to commence a fresh career for himself; but his perseverance, ingenuity, and great talents soon raised him again to a state of prosperity, and he was thus enabled to purchase an estate in the picturesque parish of Charlton, in Hertfordshire. In his later life he continued to make improvements in the microscope, and also in the art of type-founding, and discovered a means of obtaining gold in paying quantities from the acid used by jewellers to clean their wares with.

In 1813, descended from an old county family, the great inventor, whose life and achievements we are about to notice, was born at the paternal residence in Charlton, and received the name of Henry. He was

the youngest son of Mr. Anthony Bessemer, and inherited a double share of his father's inventive faculty. His education was obtained at an ordinary private school in a neighbouring county town; so that it was not to any exceptional advantages in the direction of education that the success of his after life was due. During boyhood, one of his chief amusements was modelling in clay, and he showed remarkable taste and skill in the designs which he executed in that and other substances, as well as inventive power in his early mechanical efforts. His father, seeing his abilities, presented him with a beautiful little turning-lathe; and thereupon he quickly mastered the art of turning, and produced the most wonderful patterns with his lathe.

At the age of eighteen he came to London to work out his own career, although at the time entirely unknown in the Metropolis. Here he worked at modelling and designing, and so successful was he that, when only nineteen, he exhibited one of his models at the Royal Academy. Engraving on steel with a diamond was one of the arts which he mastered, and, by doing elegant and original designs for the labels of patent medicines, he was able to earn a considerable amount of money. Another matter to which he gave attention was the production of Utrecht velvet. It had been remarked in the hearing of Sir Henry Bessemer (or of Mr. Bessemer, as we must for the present style him), that a good pattern of this fabric could scarcely be obtained; and immediately he set to work to invent machinery for producing the required article. The velvet which he made with his new machinery was largely used in furnishing the apartments in Windsor Castle, and many of the patterns still in common use were designed by him. The manufacture of Utrecht velvet has now become quite an important industry.

At about this time—that is to say, roughly speaking, about half a century ago—he met with a disappointment of his legitimate expectations which might have crushed the enterprise out of a less persevering and determined spirit. The Government in those days lost enormous amounts, estimated by some at as much as half a million sterling a year, through the fraudulent use of legal stamps a second time. There was nothing whatever to check this form of fraud. The stamps were of blue paper, and could be removed from any document without great difficulty. Consequently, unscrupulous persons took the stamps, which in many cases cost large sums, off old documents that were not wanted, and affixed them to new ones, in order to avoid paying the Government for fresh stamps. It was found that impressing the stamp on the parchment of a deed itself did not answer, since exposure to damp obliterated it. Mr. Bessemer's attention, in some way or other, was drawn to this rather serious matter; and, after devoting many months of thought and labour to the subject, and laying out no inconsiderable sum of money, he produced a totally new stamp which it was impossible to transfer from one document to another. His idea was to pierce an elaborate design right through the parchment, and he manufactured a pair of cutting dies for the purpose. Confident that the Government would not avail themselves of his invention without substantially rewarding him, he laid his system of stamping before Sir Charles Persley at Somerset House, and convinced that gentleman of the immense superiority of this new system over the old. At the special request of Sir Charles, the young inventor spent several weeks more in working out his system to greater perfection, at the end of which time it gave thorough satisfaction to the authorities, and was at once adopted by the Stamp Office. Nor was it the intention of the Government to let the ingenuity which had been devoted to the service of the public go unrewarded. The position of Superintendent of Stamps, with a salary of £500 or £600 a year, was offered by way of reward to Mr. Bessemer; and, as he was then engaged to be married, he would gladly have accepted the post. About this time, however, he called one day on the young lady of his choice, who, in a most unlucky moment of inspiration—unlucky, at all events, for him and her—suggested to him as simple and yet brilliant an idea as was ever conceived. Instead of going to the pains of piercing the parchment, why not retain the old system of stamping, only impress the date of issue on every stamp? It would then be just as impossible to take stamps from old, valueless documents, and use them again without detection, as it was impossible to transfer a stamp that was pierced through the parchment. The young man perceived at once that, ingenious as his own invention was, this was the true solution of the stamp difficulty, provided only that some simple means could be found for altering the date of the dies every day, month, and year. He soon saw how this could be accomplished, and without even doing away with the dies that had previously been in use. By a simple contrivance the old dies could be so changed that the dates impressed by them could be altered from day to day. He did not, of course, suppose that by laying before the authorities this new idea, which was even an improvement on his original invention, the fruits of all his own ingenuity and labour, as well as of the ingenuity of the young lady, would be forfeited, so far as they themselves were concerned. Yet so it proved. He explained the new plan to Sir Charles Persley; its advantages were at once perceived; and, in less than two months, an Act of Parliament was passed directing

that dated stamps, such as are still used for deeds and promissory notes, should henceforth be issued. But this latest innovation in the system of stamping rendered a Superintendent of Stamps unnecessary; and this circumstance, combined with a change in the Government which took place shortly afterwards, resulted in the utter neglect on the part of the Government of the man who had been instrumental in bringing about an improvement of such vast importance in the conduct of the nation's business. Forged, or dishonestly used stamps are now seldom heard of; but, although the country has thus been saved millions of pounds, not one shilling has Sir Henry Bessemer ever received for the services he rendered.

There is something hard, romantically hard, about the circumstances of this unfortunate business. A young lady engaged to be married innocently suggests to her intended husband an idea which, if carried out, may save the country millions of money; the young man seizes the idea, puts it into practical shape, and lays it before the Government; the Government adopt it, to the immense advantage of the country; and, instead of the young lady being handsomely rewarded, she has the mortification of feeling that her ingenious suggestion has cost her lover the fruits of his own previous ingenuity, labour, and expense. For, had the suggestion never been made, or had Mr. Bessemer, distrusting the Government, kept it secret, he would, in all probability, have received the appointment in due course which had been offered him for his original invention of a perforating die.

Of the 120 inventions which "the ingenious Mr. Bessemer," as the papers used to style him, has patented in his life, besides that grandest of them all which has made him for ever famous, we can, of course, notice but a few. The first of his inventions for which he took out a patent, consisted in certain improvements in the process of type-casting, a matter with which he had become more or less familiar when quite young in his father's foundry at Charlton. Although his type-casting apparatus was not an unqualified success, it nevertheless produced the most accurate type that had ever been made up to the date of its being patented, namely, March, 1838. In connexion with this subject, we may mention also the composing machine which he constructed, and with which for some two years the compositor's work on the *Family Herald* was done. With this machine a young lady was able to set from six to seven thousand types per hour; but the hostility of the compositors was so great that the machine was eventually abandoned.

Another among the many important discoveries of Mr. Bessemer was the art of manufacturing bronze powder. Having occasion to purchase a small quantity of this article, he was struck with the enormous difference between the price of the finished product and that of the raw material with which it was made. The materials, which could be bought for 11d., were worth £5. 12s. when converted into bronze powder. But nobody in England seemed to understand the process of manufacture. He therefore dissolved the small quantity he had bought, and having thereby ascertained its composition, he set to work to discover some means of manufacturing it. Eighteen months he vainly spent in the endeavour; and then, for a time, he gave it up. But, after an interval of six months, he resumed the task, and at last his perseverance and determination were crowned with success: he found a way to manufacture this bronze powder at a cost of something like four shillings a pound, although to this day the means by which he has produced it remains a secret. Fearing that the patent law would prove insufficient to secure him the reward of his discovery, he resolved that secrecy should be depended on instead; and the machinery which he used in the process, therefore, has never been patented. In order to ensure secrecy, he had the machinery constructed partly by one firm and partly by another, and fitted the different sections together himself. He then engaged some four or five assistants in whom he had confidence, and paid them well to aid him in his work, on condition that they kept their knowledge of the process and of the machinery to themselves. No one but himself and these assistants were allowed to enter the room in which the essential part of the machinery was set up. The strictest secrecy was always preserved, and a very handsome income was realised from the manufacture. Of the confidential assistants two or three have died ere this, and the business now no longer belongs to Sir Henry Bessemer; for he has rewarded the fidelity of the two remaining attendants by handing over to them the factory and the business.

The means with which this highly successful enterprise furnished him enabled him the better to carry on fresh experiments and bring out new inventions. The art of casting flowers in metal; the prevention of forgery in reference to bank-notes; the manufacture of paints, oils, and sugar; the construction of railway carriages, centrifugal pumps, and cannon; all these matters, and many more, engaged a part of his attention during the period of his life which preceded 1854. With some he experienced greater success, and with others less; but, whether successful or unsuccessful, from a financial point of view, he was always ingenious, energetic, and persevering. At one time he very nearly discovered the process of electro-plating, which was afterwards invented by Jacobi and others. In 1847 he wrote a pamphlet on the subject of the resistance of the atmosphere to

railway trains, in which he demonstrated the folly of the custom then in vogue of heaping up luggage on the top of railway carriages. As the resistance of the atmosphere to a body passing through it increases with the square of the velocity, he showed that an immense amount of power was wasted by a train which was travelling at a high speed with a great pile of luggage on the top.

We come now to the crowning triumph of Mr. Bessemer's life, his invention of the new method,—the Bessemer Process as it is universally called,—of manufacturing iron and steel. He had been endeavouring, about the time of the Crimean War, to induce the British Government to make trial of a new means of obtaining rotation in projectiles from cannon; but, meeting with no success at home, he induced Napoleon III. to take the matter up in France. The result of the trials at Vincennes showed that the metal of which cannon in those days were made was not sufficiently strong to make the new means of obtaining rotation a complete success; and the mind of the great inventor was thenceforth set to work to devise some method

SIR HENRY BESSEMER.

of producing a stronger material at a low cost. Although he did not all in a moment discover the new process of manufacturing steel, it was not very long before he was in the right direction. Great labour, however, and numerous experiments were necessary before he had invented the necessary machinery and brought the new method to anything like perfection. The essence of the discovery lies in the fact that, by blowing air through melted iron, certain of the impurities which are usually present in the metal can be burned away: and thus a "mild steel," of the greatest value for an infinite variety of purposes, can easily and cheaply be produced. The combustion of these impurities naturally itself gives forth enormous heat, and consequently the manufacture can be carried on with a great saving of fuel. Briefly described, the process is as follows:—Pig-iron first of all is melted, and passed in a liquid state into what is called a converter. This is a vessel suspended in such a way that it can be turned from an upright to a horizontal position, and is composed of wrought-iron, and lined either with fire-brick or with a siliceous material known as "ganister." In the bottom of this converter, which usually holds from three to ten tons of iron, are seven *tuyères*, each with seven holes, half an inch each in diameter. Atmospheric air is now blown through these holes with a pressure of fifteen or twenty pounds to the square inch, and passes up through the mass of liquid iron and out of the mouth of the converter. At the end of fifteen or twenty minutes, the current

of air is stopped, and a stream of molten spiegeleisen is run into the converter until from five to ten per cent. of the contents consists of that metal. The blast is then turned on again for a few minutes to ensure the incorporation of the spiegeleisen with the original mass of iron; and the liquid is then run off by means of an ingeniously-contrived hydraulic apparatus, into the ingot moulds. The steel thus manufactured, however, would not be sufficiently dense unless submitted to some further process; and accordingly the ingots are removed while still hot, and condensed under heavy steam hammers. Finally they are rolled into the various shapes in which they are required, especially into the form of rails for the construction of railways. The difference between the durability of an iron rail and that of a steel rail is enormous: the latter is estimated to last, on an average, from seven to nine times as long as the former.

Now the present price of Bessemer steel rails ranges from £4. 10s. to £5 per ton, whereas the price of iron rails, prior to the introduction of Bessemer steel, ranged from £6 to £7 per ton, hence, if we assume the entire annual production of Bessemer steel rails to be 3,000,000 tons, costing £15,000,000 sterling, and assuming also that the wear of that steel is no more than five times greater than iron, it follows that these 3,000,000 tons will take the place of 15,000,000 tons of ordinary iron rails, which, at £6 per ton, would have cost £90,000,000, or £75,000,000 more than the Bessemer steel rails, which have superseded their use in every country in the world.

Having taken out several patents, in order to secure to himself the fruits of his labour, Mr. Bessemer proclaimed his new method of manufacturing steel to the world, at a meeting of the British Association held at Cheltenham in 1856. He had mentioned the subject incidentally to Mr. George Rennie, the President of the Association; and so taken was that gentleman with the new idea, that he not only included Mr. Bessemer's name among the names of those who were to read papers, but placed it at the very head of the whole list, in order that the wonderful discovery might receive a full share of attention from the scientific and manufacturing world. The paper in which the discoverer proclaimed his new system to the meeting of scientists was entitled, "On the Manufacture of Iron and Steel without Fuel." So novel did the title sound, that there were some among the engineering world who even laughed at it, apparently believing the whole thing was a hoax. But the marvellous success of the new process very soon turned the laugh against these gentlemen. In an amazingly short period, the manufacture of Bessemer steel became a permanent and important industry in every iron-producing country, including Great Britain, the United States, Germany, France, Sweden, Russia, and Belgium. In the year 1883, the following amounts of steel were produced by this process in the first four of the above-mentioned countries:—

Great Britain	1,553,380 tons
United States	1,654,627 ,,
Germany	1,255,000 ,,
France	365,980 ,,
Total	4,828,987 tons.

When it is stated that previously to the introduction of the Bessemer Process the production of steel in Great Britain amounted to only 51,000 tons a year, and that the price of it, when produced, was not very far short of ten times the price of steel at the present day, some faint idea may be formed of the benefits which the new process has conferred on the world; but thoroughly to grasp the effects which have already, in less than a third of a century, been produced, is altogether too great a task for the mind. It has been calculated that, within twenty-one years after the first successful working of the new process, the total amount of steel which had been produced by it would have cost, if turned out in the old way, no less than £1,000,000,000 more than it actually did! Few inventions have been more rapidly taken advantage of than this which we have been describing, and few have proved so successful from the inventor's point of view; and few, too, as we intimated above, have been found by later engineers so incapable of being improved upon. Among the innumerable purposes to which Bessemer steel is already applied, may be mentioned, as being of special importance, the construction of railways, of mercantile vessels, of armour-plate for ships of war, and of boilers for steam-engines. The whole iron trade has been revolutionised by the invention.

Nor have numerous honours and distinctions failed to flow in upon the great inventor, although to give a complete account of them all would occupy too much space. Foremost among them, of course, stands the honour of Knighthood, which was conferred upon him at the suggestion of Lord Beaconsfield. Sir Henry Bessemer, as he then became, had hitherto received from the Government of his own country no special marks

of distinction, and but scant justice; but in this manner Lord Beaconsfield endeavoured to make up for the past. Foreign countries were very ready with their recognitions of his services in the cause of science and manufacture. The King of Wurtemberg presented him with a Gold Medal, accompanied by a most complimentary letter. In Austria the honour of a Knight Commandership of the Order of His Imperial Majesty Francis Joseph, was conferred on him by the Emperor. The Iron Board of Sweden made him an honorary member of their body; and the Freedom of the City of Hamburgh was presented to him by the municipality. In France, too, his achievements were highly appreciated; and the late Emperor of the French, with his own hand, gave him a magnificent Gold Medal in proof of this appreciation. In America, so much was thought of the inventions of Sir Henry Bessemer, that a new city which was there laid out was named "Bessemer," after him. At home he was awarded the Telford Gold Medal by the Institution of Civil Engineers, and the Albert Gold Medal by the Society of Arts. He was presented with the Freedom of the Turners' Company, and with that of the Cutlers' Company, and in 1879, after a banquet had been given in his honour at the Mansion House, with the Freedom of the City of London. He was also elected President of the Iron and Steel Institute, and his term of office was signalised by the establishment of the Bessemer Medal, which has since been awarded to many men of great distinction in the world of science and commerce. In 1879 he was elected a Fellow of the Royal Society.

The latter part of Sir Henry Bessemer's life has not been passed in mere idle enjoyment of the princely income which his great inventions have brought him. He is never satisfied unless engaged in improving something or other. But many of the matters which have engaged his attention in recent years have been more calculated to benefit the public than to increase his own fortune. His high-pressure furnace was an ingenious apparatus for obtaining a greater temperature than could be obtained in ordinary furnaces. It is a well-known law of nature that the volume of a gas varies as the temperature, and inversely as the pressure to which the gas is subjected. Applying this principle, he constructed a furnace in which the gaseous matters contained in the furnace were subjected to and retained under considerable pressure, and by this means he obtained sufficient heat to fuse substances which would otherwise have resisted all attempts. Another matter to which he has given attention is the casting of steel under hydraulic pressure; in fact, the application of hydraulic power in general to manufacturing and other useful purposes is largely indebted to him for its development.

Another matter, also, to which he has paid attention is the coal supply of London; and on this subject he wrote an able letter to the *Times* in 1882. He was struck on the one hand with the enormous amount of labour which is expended in bringing coal from the coal-mines to the Metropolis, and, on the other hand, with the benefit which would be conferred on London if less coal were consumed there, and, consequently, less smoke generated. His suggestion we cannot do better than give in his own words:—"Why should we not at once connect London with one of our nearest coal-fields by means of a copper rod of one inch in diameter, and capable of transmitting 84,000 horse-power to London, and thus practically bring up the coal by wire instead of by rail. Let us see what is the equivalent in coal of this amount of motive power. Assuming that each horse-power can be generated by the consumption of three pounds of coal per hour, and that the engines work six days and a half per week, we should require an annual consumption of coal equal to 1,012,600 tons to produce such a result. Now, all this coal would, in the case assumed, be burned at the pit's mouth at a cost of 6*s.* per ton for large, and 2*s.* per ton for small coal—that is, at less than one-fourth the cost of coal in London. This would immensely reduce the cost of the electric light, and of the motive power now used in London for such a vast variety of purposes, and, at the same time, save us from the enormous volumes of smoke and foul gas which this million of tons of coal would make if burned in our midst."

Among the more recent of Sir Henry Bessemer's accomplishments, is the construction of a novel telescope of immense size, with a glass speculum instead of a metal one, and with marvellous arrangements for easily directing it to any point in the heavens. It is located in the observatory which he has built on his beautiful estate at Denmark Hill, just outside London.

With regard to his private life, we may just say in concluding, that he was married in 1833 to the daughter of Mr. Richard Allen, of Amersham, and that the children of the marriage have been three in number, two sons and one daughter. He has never taken any active part in politics, and, indeed, has always been far too busy with other things to do so. For even when not engaged in evolving some important invention, he is always interested in scientific and engineering questions. It is, no doubt, this devotion to practical science combined, on the one hand, with perseverance, and, on the other hand, with a singular talent for seeing through difficulties and suggesting remedies, that has been the cause of the wonderful success of this remarkable man.

Messrs. Cox & Yeman, London.

THE pastimes of Old England have unquestionably been developed in modern times in two distinct and pre-eminently noteworthy directions. Her sons stand unrivalled in the field amongst the nations of the world for their manly, healthful game of cricket; and within-doors, who can deny that they are unapproached in billiards? Of course, there are weighty reasons why such should be the case, and an inquiry into the history of their successes will show that they have originated and been developed, as all other things have been from time immemorial, by a combination of exceptionally favourable circumstances.

Our business for the present is concerned with the question of billiards as such. We have heard of marvellous double and treble canons from one small French table on to another, and so on; of how the performer had seemingly been able to control the movements of the ivory spheres as though they were endowed with life and sense. But such feats of legerdemain cannot compare with the steady dexterity of a Roberts or a Cook upon one of our first-class full-sized English tables, where a multiplicity of causes arise to thwart the player's utmost skill, and where the slightest imperfection in the table becomes magnified into an insurmountable barrier. If one of the eminent champions were questioned upon the subject, he would in honour be bound to confess that what is in reality a wonderful exhibition of skill on his part, would become an utter impossibility if he were not assisted by the provision of an equally wonderful table to play on.

We come now to the billiard table *per se;* but before we enter into any synthetical examination of that "beautifully and wonderfully made" implement, let us pay a tribute to Mr. Cox, the head of the eminent Firm of Messrs. Cox & Yeman, billiard-table makers (of 184, Brompton Road, London, S.W.), whose portrait from a photograph by Downey of Ebury Street appears on the next page of this notice. The name of Mr. Cox must always be coupled with the highest possible development of a business which the sequel will prove to be one that entails consideration of culture in science, art, and commerce of a high standing. There are, indeed, but three Firms in Great Britain who are considered capable of turning out tables adequate to the requirements of the champion tournaments, and we have chosen that of Messrs. Cox & Yeman for review, as peculiarly an exemplification of the doctrine of the "survival of the fittest."

To produce a billiard table, such as the one now to be examined, an immense outlay of capital is required, and that partly accounts for the scarcity of first-class manufacturers. The timber, after being sawn at the mills, is taken to the extensive factory, which consists of a range of buildings, four storeys high, and occupying a depth of 158 feet, from the Brompton Road to Cheval Place in the rear. These buildings are wholly devoted to the special business of manufacturing tables, balls, cues, marking-boards, gas-fittings, cushions, seats, and every other requisite for the billiard-room. Even all this space is quite inadequate for the proper display of the stock in hand, which has to be packed away in sections.

Let us pass through the building direct to the general workshops, and there commence our survey. Here we find materials in profusion for the making of sides, legs, beds, cues, &c. Now, a great many important things have to be duly considered, and practically carried out, before the construction of a billiard table can be commenced. All the wood to be used ought to be perfectly desiccated, so that neither contraction nor expansion, and consequent warping of the wood, may ensue after the table has been made. To procure such wood the Firm do not rely upon the word of others, but purchase suitable varieties and stock them for years under conditions that cannot fail to prove satisfactory, and even then the wood is subjected to severe practical tests before it is selected for use. The specific gravity of each slab of slate to be employed for the construction of the beds is carefully ascertained, so as to secure only homogeneous samples, *i.e.*, pieces that are free from injurious metallic or other impurity, liable to prove disadvantageous in the after history of the table. These slabs are further polished and finished with the utmost nicety, under the personal supervision

MR. COX.

of Mr. Cox, who can thus guarantee the perfect fitting of joints and general reliability of the entire structure. It thus appears that no inconsiderable amount of scientific acumen and practical knowledge is brought to bear upon a subject that may, at first sight, appear to be altogether commonplace and mechanical; an accurate knowledge of the physical properties of materials is thus one of the most distinctive features of this department. Great care is taken to keep the workshops in good condition as regards the temperature of the atmosphere; the system adopted for doing so during both day and night is contrived upon the most approved of modern fireproof methods.

The wood is shaped, turned if required, carved, and polished, for each of which processes there are special departments and skilled workmen, and is then returned to the stores and show-rooms, ready to be set up. This department is under the superintendence of Mr. Cox, jun.

The skeleton table, fitted with slate bed and woodwork, has next to be provided with specially-made india-rubber cushions; these cushions are exactly adapted to the set of slates which has been selected for them, and this department is one which calls for nothing short of the most unqualified praise. Some

years ago the cushions used to be made of solid india-rubber, and were invariably attended by disastrous results. Changes of temperature so affected the mass that its molecular constitution underwent alteration, and the elastic condition finally gave way to a more or less brittle state, so that it ultimately cracked and became "untrue." To Messrs. Cox & Yeman belongs the honour of having discovered the cause and overcome this serious drawback, by the ingenious contrivance of a series of elastic bands, made of specially treated india-rubber, eight of which, of varying widths and thicknesses, are combined to build up a single cushion, whose stability has now been conclusively proved. We consider this to be a *chef-d'œuvre* of applied physical science, and it marks an epoch in the history of this special manufacture. As may be supposed, the most delicate manipulative skill is required in the consummation of this happy result, and the head of this department has had the experience of over forty years, and has fitted cushions to over 2,000 tables. Messrs. Cox & Yeman are, indeed, fortunate as far as regards their staff of employés, the majority of whom have been with them for many years.

The skeleton table, so far, now stands complete, and has to be covered with cloth. The superb material employed by the Firm is specially produced for them in Gloucestershire, and their stock in hand is usually of the value of not less than £4,000; and for texture, beauty, and durability it has not hitherto been equalled.

Large stocks of timber, stored upon the roofs of the workshops, bear testimony to the fact that the rule of the Firm is to thoroughly season their own timber; after it has been removed from the roof, the process of desiccation is still further carried out, and so efficiently that the wood which is allowed to pass muster is not prone to contract or expand during changes of the weather by even the thousandth part of an inch.

The cue-room next engages our attention, where every variety of cue may be examined. The shafts are all made of the best ash, and into the ends of these are let in butts made out of a variety of exquisitely-grained fancy woods, such as ebony, rose, walnut, mahogany, tulip, Russian maple, &c. The ingenious machine, by means of which these cue-handles are accurately let into the shafts, is well worthy of special notice.

Next come the stock of ivory balls, for the manufacture of which Messrs. Cox & Yeman are so justly celebrated, that they not only supply clubs possessed of tables other than their own make, but also produce them largely for export. Their extensive business in this commodity has arisen from the simple fact that, "whatever they do, they do thoroughly well"; they choose each piece of ivory with scrupulous care, and it is carefully weighed before being turned; in fact, so much care is exercised with the balls used for matches and clubs, that they are guaranteed to be exactly one size, and not to vary in weight half a grain.

Lastly, in passing through their show-rooms, one cannot but be struck with the thoughtful care bestowed upon items of collateral interest. They have truly "not left a single stone unturned" to ensure success, for we find a model billiard-room, designed by Mr. Cox, in which perfect provision is made to secure the distribution of light from the skylight above, so as to illuminate the whole surface of the table uniformly during the hours of daylight. Billiard players have ample cause to regret the ineffective lighting of the table by day in the majority of public rooms designed for their accommodation; and architects and others who contemplate building such apartments would do well to consult Mr. Cox before doing so.

The illustration given on the next page represents a portion of the table shown by this eminent Firm at the recent International Inventions Exhibition, where it gained the only award made for full-sized billiard tables. This elaborate piece of work was also exhibited at Edinburgh in 1886 and was awarded a Silver Medal.

It may be as well to record in this place a few matters of fact respecting Messrs. Cox & Yeman's tables. They have supplied no less than 900 tables for Scotland alone; they keep up a staff of nearly forty men constantly on their premises, and five in the provinces fitting up tables; they were the first to introduce the low cushions which enabled the player to strike a ball accurately when close to the cushion, and were first used for the Oxford and Cambridge Inter-University Matches, 1865; they produced the first championship table for the match between Cook and John Roberts, sen., when the former wrested the honour so long held by the latter; and they made the special table for the match at the Criterion, in which the younger Roberts deprived Cook of his chance of holding the cup which would otherwise have become his own property. The magnificently-carved walnut table, which was made for the contest between Roberts, jun., and Cook before the departure of the former for India, was purchased by H.M. the King of Siam. The Firm have been patronised by all the champion players for the past twenty-eight years, and the most celebrated and fashionable clubs in London possess their tables.

Although the cost of a private billiard-room is necessarily heavy, there are many who are deterred from

adding one to their homes under the mistaken notion of inordinate expense. Such persons may be agreeably surprised to find that Messrs. Cox & Yeman are prepared to fit up a room with table and all necessaries for billiards, for a sum so moderate that it brings this luxury within the reach of many who would

PORTION OF BILLIARD TABLE SHOWN AT THE INVENTIONS EXHIBITION.

otherwise be compelled to abandon the idea. In conclusion, we may fairly congratulate the Firm in general, and its distinguished head in particular, upon their unchallenged position as the first manufacturers of high class billiard tables in the world, a statement which nearly every accomplished player in the land would be only too ready to substantiate.

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Messrs. Huntley & Palmers, Reading.

READING, one of the ancient towns of England, tracing its history back more than a thousand years, and always holding an important position in religion, in politics, and in trade, is now the home of one of the most important manufactories of this country. For many years it had its manufactories of cloth, silk, and velvet; but these have passed away to other towns. In their place the manufacture of biscuits has been the means of making Reading more noted than at any time in its previous history.

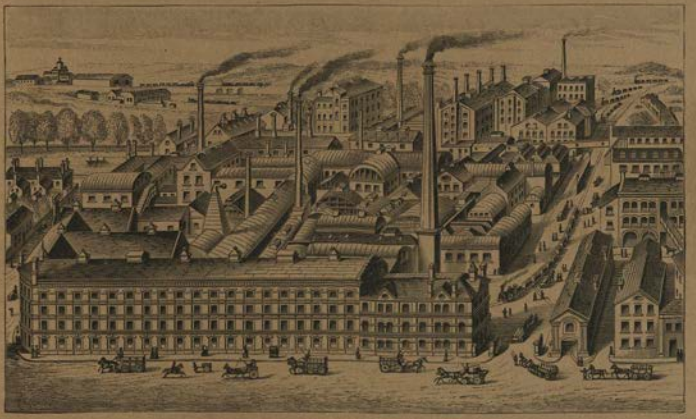
Probably no trade has shown a greater development during the reign of Queen Victoria than that in biscuits. When the Queen ascended the throne in 1837, the manufacture of this agreeable article of diet was quite insignificant, employing few hands, and practically no machinery. In those days biscuits were luxuries, or, as a necessary, confined to travellers or English residents in hot climates. About that time machinery began to be introduced, and the foundation of the present extensive commerce was laid. A small wholesale trade in biscuits existed in Reading at the time of the accession of the Queen, and not long after the commencement of her reign, Mr. George Palmer joined the late Mr. Thomas Huntley in his business, and the Firm of Huntley & Palmers commenced their career, introducing machinery into the manufacture of biscuits, and, following rapidly the development of railways, steamboats, &c., laid the foundation of the largest biscuit manufactory in the world, few establishments in the kingdom having grown so rapidly or expanded so extensively as that of Huntley & Palmers. By the aid of magnificent machinery, and an army of experienced workmen, many thousands of pounds of delicate and delicious dainties are daily made, packed, and sent away to the four quarters of the globe.

During the last fifty years the population of the town of Reading has increased from 16,000 to nearly 50,000, and this increase has been largely due to the extended biscuit-works which now give employment to between 3,000 and 4,000 men and boys, women and girls. These numerous workpeople are practically employed in one building, the large collection of factories and warehouses being more or less connected. On passing along the King's Road, the part of Reading in which Huntley & Palmers' manufactory is situated, the long and handsome façade of the works is presented to one's view. If we ask a passer-by what that building is, we probably receive as an answer, "The Factory," every one being supposed to know that "The Factory" in Reading means the biscuit manufactory of Huntley & Palmers. It is just one o'clock, and as we pass the gates we find ourselves in the midst of workpeople of all ages hurrying out of the gateways, while, as we look down the yard, we see a great mass of people coming towards us with quickened step and earnest purpose, going right and left as they emerge from the buildings. It is the dinner-hour, and there is no loss of time, no delaying; the thousands who have passed out are soon out of sight, and for a brief time may be found with their families in all parts of the town. We find on inquiry that the factory is closed

for an hour, so, like the workpeople, we depart for a similar object, and on our return are in time to see them enter for the afternoon employ. Our application for admission being granted, after having produced our credentials, which the Firm are vigilant in demanding, we are shown over the Works, and initiated as to some of the mysteries of biscuit-making.

The River Kennet runs through the middle of the buildings, which are connected by bridges, one being a railway bridge, the whole of the works being in direct communication with the railways,—viz., the Great Western, the South-Eastern, and the South-Western Railways,—and the goods are loaded into the trucks in warehouses and sent direct to London, Manchester, Liverpool, Edinburgh, and other great centres of population in England, Scotland, and Wales, and for shipment from the different ports to all parts of the world.

Entering the manufactory, we find ourselves in the most delightful climate,—a genial warmth and the odours of spiceland. We are shown the raw materials being rapidly manipulated by the most perfect machinery into all kinds of biscuits, cakes, nuts, &c., the machines apparently doing all the work,—rolling, cutting, and



MESSRS. HUNTLEY AND PALMERS' WORKS, READING.

even baking being performed by machinery; biscuits of every kind, to suit every taste, and adapted to all ages and conditions of life: food for the baby, biscuits for the children, for the invalid, the dyspeptic, the delicate; biscuits hard and soft, with and without sugar; biscuits for butter or cheese, for lunch or dinner, dessert, tea, or supper; biscuits for travellers or sportsmen, for parties, and fêtes,—more than 300 varieties in make, size, and shape. As we walk through the various rooms and see all these different kinds of biscuits rolling out of the ovens, beautifully baked and of almost uniform colour, we realise to the fullest extent the perfection to which Huntley & Palmers have brought the manufacture of this one article of food; and, as we try to estimate the extent of this enormous business, and think of the flour, sugar, butter, eggs, and other materials used in this one manufactory, and of the capital, the industry, and the population engaged in producing the materials added to the workpeople now employed in the manufactory itself, we realise how important has been the rise of biscuit-making as one of the industries which have been developed during the reign of Queen Victoria; and that in the magnitude of its resources, the complete adaptability of its appliances, the far-reaching area of its operations, the firm of Huntley & Palmers stand supreme,

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and that the development of the biscuit-making industry, as typified at Reading, is one of the most unique examples of commercial success under the happy conditions of Her Majesty's reign.

By well-organised and directed efforts, Huntley & Palmers have maintained unblemished the traditions and actualities of British industry and trade; they have obtained a reputation over the whole world for an article of diet, once a luxury but now a necessary, which in quality and appearance cannot be surpassed.

Speaking of their honours, the Firm have for many years sent their biscuits direct to Windsor Castle, and are thus entitled to style themselves Biscuit Manufacturers to the Queen. They have also supplied direct some of the other Courts of Europe. In the celebrated Great Exhibition of 1851 their goods were duly represented, and the Firm have been exhibitors in most of the important Exhibitions since, obtaining many medals, while at the Paris Exhibition in 1878 the special "Grand Prize" was awarded to them, accompanied with the following testimonial:—"Unrivalled House, known throughout the world for its enormous production and for the excellent quality of its manufactures."

In addition to biscuits, Huntley & Palmers are large manufacturers of cakes in great variety, their wedding-cakes frequently going to India, China, and other distant parts of the world, as well as being found on many a wedding breakfast-table in the old country.

Besides those employed in the manufactory and warehouses, there is a large staff of clerks in the range of offices at Reading; also an establishment in London, where some of the partners are resident, conducting the extensive London, Continental, and foreign business of the concern,—a necessary condition of such a world-wide trade. Numerous travellers also are engaged in representing the Firm in England and abroad.

Huntley & Palmers' manufactory has been visited by many persons of distinction, by representatives of foreign countries, members of the Royal Family, and in 1882, at the time of the show of the Royal Agricultural Society, by H.R.H. the Prince of Wales. One of the outcomes of the biscuit trade has been the introduction of biscuit-boxes made in a great variety of shapes, and of various metals, glass, and china, many of these boxes being elegant in design and beautiful in decoration; and, perhaps, in no way is the universality of biscuit-eating more fully illustrated than in the fact that no house is considered furnished that has not, as part of its equipment, one of these biscuit-cases.

On the death of Mr. Thomas Huntley in 1857, Mr. George Palmer's two brothers, Mr. Samuel and Mr. William I. Palmer, joined the concern, and at the present time, three of Mr. George Palmer's sons and two of Mr. Samuel Palmer's are members of the Firm.

Despite the intelligent explanation which is accorded upon all reasonable points of inquiry, it is not by means of one visit that the magnitude of the science and art of biscuit-baking can be grasped in its entirety. To pursue with an observant eye our course through the labyrinth of the Reading factory is to obtain, at the best, but a dim notion of the reality. We are, after all, only conscious of an admirably-devised scheme of operations, and of the tangible proofs of its efficient progression in the bakeries, machine-rooms, and well-filled stores by which we are surrounded. The scrupulous cleanliness which is observed in every department is a feature which cannot be forgotten. Access to the various sections of the buildings is gained by means of lifts, and trains are kept busily going from one portion of the factory to another, either loaded with the various articles required during the course of manufacture, or in transferring the biscuits across the river from one warehouse to another. One large building is devoted to the storage and grinding of sugar; and there are also outlying buildings for the construction of cases, barrels, &c., and for the manufacture and repair of the machinery. The extent and the ramifications of the export trade are truly colossal, and so complete are the arrangements of the Firm for the distribution of their manufactures, that the pleasure-seeker in Paris and other cities of Europe, the hunter on the prairies of America, the bushman in Australia, the traveller in India or in China, or the "all-the-world-round" voyager, can generally find in his travels the Reading biscuits, and in them a wholesome, agreeable, and nutritious food.

The foregoing sketch will, perhaps, afford some idea of the extent of Messrs. Huntley & Palmers' productive resources, and the importance of the manufacture carried on at their works. Regretfully taking our departure from the Factory, we may heartily wish increasing prosperity to the Firm, which has been the pioneer of one of the most delicate, and withal useful, industrial arts in Great Britain.

The Leeds Forge Company, Limited, Leeds.

TEAM has proved one of the most widely useful and universally beneficent of the forces ever brought under control by the genius of men. By its agency coal is made to minister in an infinite variety of ways to the wants of society. The steam-boiler is, so to speak, the heart from which flows the vital fluid that animates the various machines employed in different branches of trade, and it forms thus one of the most important adjuncts to manufacturing industry. Indeed many of the improvements which have been made in the steam engine have resulted from an improved construction of the boiler. It is well known that the higher the pressure of steam, and the greater the grade of expansion, within certain practical limits, at which steam is used, the greater will be the economy. Hence the various attempts that have been made to introduce boilers capable of bearing high pressure.

Such efforts have not, however, been uniformly successful, by reason of the weakness inherent in internally flued boilers, the flues of which have often been a great source of danger. But this serious difficulty has, fortunately, been overcome by Mr. Samson Fox, C.E., the founder of the Leeds Forge Company, to whom belongs the credit of having revolutionised the hitherto received notions as to the amount of pressure at which steam boilers can with safety be worked, and of having produced, by his inventive skill and indomitable energy, that with which his name has become inseparably connected—the Fox Corrugated Flue. This type of flue is now used in the boilers of nearly every fast steamship which has been built during the past eight years, and in almost all first-class land boilers constructed within recent years. Mr. Fox's valuable invention consists in corrugating the surface of a tube in the direction of its circumference, by which simple process the strength of the tube so treated is increased from four and a half to six times in its capability of resisting a collapsing pressure. When it is considered that this is done without any increase in weight of material, and when the practical reasons are borne in mind which do not allow a thick plate to be used at that part of a boiler where the heat of the fuel has to pass through to the water, the value of forming a plate in such a manner that its conductivity is not interfered with, while its resistance to collapse is increased to the extent before named,—when all this is remembered, the great value of this invention to modern Engineering Science will at once be apparent to the mechanical mind.

To trace the career of one who has thus benefited his time and generation falls legitimately within the province of the present work. Mr. Samson Fox, the inventor and patentee of the Fox Corrugated Boiler Flue, was born near Leeds, and received his education at the village school. At an early age he commenced to work at a weaving-loom, but, following the bent of a naturally mechanical mind, turned from this to be apprenticed in one of the large engineering establishments in Leeds. Being a man exceptionally gifted he soon rose to be in turn managing foreman, designer of special machinery, and representative to the Firm with whom he had served his apprenticeship. His keen insight soon showed him that there was a good opening for the establishment of

Works for the production of high-class boiler material; and with that promptness of action characteristic of a shrewd man of business he soon set to work to realise his project, the result being that in 1874 was founded the Leeds Forge Company, Limited, of which concern Mr. Fox has ever since been managing director. An estate of nineteen acres was bought at New Wortley, Leeds, and upon it were erected large factories specially adapted to meet the particular requirements of the business. With that thoroughness which stamps the character of all great leaders of industry, Mr. Fox planned the Works upon a comprehensive scale, so that machinery should wherever possible replace hand labour, while time should also be economised, the arrangements being such that each piece of work in course of manufacture is passed on from stage to stage without traversing twice the same ground. The machinery throughout is of the most modern and improved construction, much of it embodying important improvements made by Mr. Fox himself. A capital portrait of this gentleman is given herewith.

A brief *résumé* of the processes carried on will help to an intelligent appreciation of the business itself. In order to insure a uniformly high quality of the steel employed for Fox's Corrugated Flues, special steel

MR. SAMSON FOX, C.E.

furnaces have been erected on the Siemens system. The charge of each furnace is some fifteen tons of metal, the conversion of which occupies about eight hours, and the resulting product is mild steel of from 24 to 27 tons tensile strength, with elongation in ten inches of about 30 per cent. This material, though called steel, is of such a nature that, when heated to redness and plunged in water at 82 degrees Fahr., it will not temper, and will satisfy the bending tests prescribed by the Admiralty, the Board of Trade, and Lloyds.

The forge, like every other department, is of very large proportions. The metal is by the aid of ponderous steam-hammers made to assume a shape convenient for its further manipulation by the rolls. The latter, which are of immense power, and will roll plates up to nine feet wide, are driven by a pair of condensing steam-engines of 250 horse-power. Having been properly cut and trimmed, the material is next bent into the form of huge tubes. The edges of the tube are then welded together by the aid of most ingeniously contrived machinery invented and patented by Mr. Fox. The plant provided in this department includes gas and air furnaces and automatic travelling steam-hammers so arranged that no time is lost between the furnace and the anvil, and by the conjoined action of these various appliances a sound, clean, and perfect weld is secured.

From here the cylinder is passed on to the corrugating mill, a massive machine, also invented by Mr. Fox, which is driven by a pair of engines of 1,000 indicated horse-power. After the tube has been heated to a uniform bright cherry red, it is placed in the rolls; the upper roll slides inside the welded cylinder, auxiliary rolls centre the flue, and the two main rolls being brought close together by hydraulic power, impress the corrugations into the plate. At a single revolution of the flue it becomes completely corrugated, and is thus rendered capable of resisting a pressure, as before briefly mentioned, four and a half times greater than when in its original plane form. The Corrugated Flue is kept revolving in the mill for a little while until it has cooled sufficiently to allow of its removal without any risk of being put out of shape. During this operation the auxiliary rolls also keep revolving, and thus insure that the cylinder shall form a perfect circle.

From here the tubes are conveyed to the flanging and finishing shops, which are doubtless the largest of their kind in the world, covering upwards of two acres. Here the tubes are again heated in open furnaces, and the flanging and peculiar shaping of the ends is then effected by hand. The machinery at work in this department includes steam-engines, bending and straightening rolls, steam-hammers, presses, blast-engines, &c. Special mention may be made of an hydraulic press, made according to Mr. Fox's design, capable of exerting a force of 5,000 tons, and is used for flanging the end plates for boilers, and in the manufacture of Mr. Fox's latest invention of Flanged Frame-plates for Railway Rolling Stock, which are fashioned at one heat by hydraulic pressure, and are provided with facing strips for the attachment of the necessary fittings. The object has been to produce a frame-plate sufficiently rigid, transversely and longitudinally, without the necessity of angle iron stiffeners, and at the same time to reduce the cost of the manufacture.

Hitherto frame-plates have been made up of pieces of material riveted together, or the frames of wagons or carriages constructed partially of iron and partially of wood: Fox's Flanged Frame-plate is in one piece, and is much more serviceable and enduring than a frame-plate built up in sections. It also possesses the recommendation of being an article which can be produced of exactly the same size a thousand times over.

Many other subsidiary operations are carried on at these Works which we need not describe. Reference must, however, be made to the testing-house, where the plates for marine boilers, &c., are tested as to strength and ductility in order to meet the requirements of the Admiralty, Board of Trade, and Lloyds. It is, perhaps, hardly necessary to point out that the tests made under the supervision of representatives from these three official bodies are of the most exacting nature. The process consists in subjecting a small strip cut off from each steel plate to a strain ranging from 10 lb. to 80 tons. Its tensile strength is thus correctly ascertained and duly recorded. The completed Corrugated Flues are also tested here, and demonstrable evidence is thus afforded of their truly marvellous superiority over those of the ordinary type. Let it be remembered that whereas an ordinary plane surface flue of a given thickness will withstand a pressure of 150 lb. to the square inch, one of Fox's Patent Corrugated Flues will resist the enormous pressure of 900 lb. to the square inch!

In the light of this fact it is no wonder that these flues are meeting with an ever-increasing demand, abroad as well as at home, for both marine and land boilers; and that some thousands are annually produced to meet current requirements. Repeated experiments on long sea voyages have shown the great economy arising from the use of high-pressure steam generated in boilers fitted with Fox's Corrugated Furnaces, and the use of triple or quadruple expansion engines, as compared with the use of steam at about one-half pressure generated in boilers with plane furnaces, and of ordinary compound engines. Practical proof of the vast superiority of these patent boiler flues is, moreover, afforded by the fact that they are now almost exclusively used in the principal vessels, both in the Royal Navy and the Mercantile Marine, where they are working at pressures as high as 184 lb. per square inch; and the number of steamships fitted with Fox's Corrugated Flues exceeds, probably, one thousand.

The Works which we have described above are one of the sights of the Leeds district, and rank among the most interesting in the kingdom. They have proved an attraction to many distinguished visitors from different parts of the world, who have been privileged to witness here the whole of the operations including the conversion of the pig-iron and iron ore into mild steel, and successively into the finished boiler-plates and Corrugated Flues, to the production of which two specialties the Leeds Forge Company mainly confine their attention.

From the foregoing remarks it will be seen that by placing within the reach of the trading community machinery greatly accelerating the speed of vessels, and at the same time decreasing their weight, Mr. Samson Fox has conferred lasting benefits upon this and other nations; and, by dint of great knowledge, practical experience, extreme care, and patient skill, he has helped to build up a business which, under his energetic management, continues to hold an unrivalled position.

Mr. Bernard Quaritch, London.

BERNARD QUARITCH, the celebrated bookseller, of Piccadilly, was born at Worbis, in Prussia, in 1819, but has been for many years a naturalised British subject. He was apprenticed to a bookseller at Nordhausen, in whose service he remained from 1834 to 1839; and then went for three years to a publishing house at Berlin. In April, 1842, he came to London, and found employment in a subordinate capacity with the well-known publisher, bookseller, and bibliographer, Mr. Henry George Bohn. To the two years passed in Bohn's house we may trace the foundation of the remarkable fund of book-lore which Mr. Quaritch subsequently amassed. It was at this time that he made the acquaintance of Lowndes, the author of "The Bibliographer's Manual," who was likewise in Mr. Bohn's service; and the old man often sought the aid of young Quaritch, before he passed away, almost in the arms of his friend. In 1844 and 1845, the subject of our notice was in Paris with Théophile Barrois, a bookseller of high repute, distinguished for his shrewd and forcible phrases, his keen humour, and common sense. It is noteworthy that the great bibliographer Brunet, whose acquaintance Mr. Quaritch made at this time, predicted the young man's future eminence as a bookseller,—a prediction which Lowndes had anticipated by a somewhat similar utterance two years before.

Between 1845 and 1847, he was working again in London in the service of Mr. Bohn. During this period he compiled the only printed volume of Bohn's 1847 [Classified] Catalogue, a far more creditable performance than the celebrated "Guinea Catalogue," of 1841. The year 1847 was an epoch in his life, for it was in the April of that year that he started in business for himself. He began, however, on a very small scale, with no capital but a small sum saved by the exercise of the most rigorous self-denial.

In the following November there appeared the first of the series of Catalogues which will perpetuate Mr. Quaritch's name. It was entitled "Quaritch's Cheap Book Circular," and consisted of only a single leaf—a little broadside, in fact,—in three columns, containing the titles of about 400 books, marked with prices averaging from eightcenpence to two shillings. The list included De Moivre's "Doctrine of Chances," a well-known work upon a subject which has always engaged Mr. Quaritch's attention and influenced his practice. In 1848, the "Catalogue" had reached its fifth number, but with an alteration both in size and name. The octavo form was adopted, and the title selected was "Catalogue of Foreign and English Books." A modification, however, was temporarily in use between December, 1854, and May, 1864, in order to secure the same favourable postal conditions as a stamped newspaper; with this object, the title of *The Museum* was prefixed to the ordinary title.

A chief feature of his business was the collection of linguistic and philological works, then more in request than now; and thus a number of the best scholars of the country were drawn gradually to form a *clientèle* for the rising bookseller, with whom most of them remained ever afterwards in friendly relations. This branch of his trade received a stimulus from the Eastern complications which preceded the great Crimean War;

and also led to the publication of some works of Oriental philology. In 1854, he published Barker's "Turkish Grammar"; in 1856, Faris's "Arabic Grammar"; in 1857, Redhouse's "Turkish Dictionary," and Bleeck's "Persian Grammar"; and in 1858, Catafago's "Arabic Dictionary." In 1866, he brought out a new edition of Faris; in 1873, a second edition of Catafago; in 1879, a new edition of Redhouse, enlarged and improved by Dr. Charles Wells; and in 1880, Dr. Wells's "Turkish Grammar." These last two works were printed by the firm of Wyman & Sons, so long identified with Oriental typography. In 1883, he produced a third edition of Faris.

His old-book business was now about to take a new direction, which led to its highest development and prosperity. For some years his remarkable memory, great natural gifts, and unceasing application, had been turned towards utilising an increasing experience of the rarer and more expensive books, and his resources had simultaneously augmented, so that when the Bishop of Cashel's library was sold by auction in February, 1858, he was enabled to add costlier and more important volumes to his stock. It was on that occasion that he bought a copy of the Mazarine Bible for the sum of £595. In the same year he published his first (relatively) large Catalogue of Books. It consisted of 182 pages, printed in double columns, and comprised nearly 5,000 articles. This was followed, two years later, that is in 1860, by his first complete Catalogue with an alphabetical Index. It extended to 408 pages, and included 6,574 numbered articles; the Index represented about 7,000 entries. M. Libri's great sales in 1859 and 1861, and the Van Alstein sale at Ghent, in 1863, supplied Mr. Quaritch with further opportunities. As a result, he printed, in 1864, a still thicker Catalogue than that of 1860, but without Index. In 1868, the stock had grown so much that another large Catalogue was published, consisting of 1,080 pages, 15,000 articles, and an Index of 50 pages in treble columns. A still more extensive volume came out in 1870, containing 1,194 pages, without Index. The last section of this Catalogue was entitled "Catalogue of Manuscripts, Block-books, and Early Productions of the Printing-Press." Amongst the articles described in it were sixteen Greek MSS.; a Latin Evangeliary, written in the Abbey of Prüm in 1040; a MS. German Bible dated 1445, with a large *engraved* initial; a curious volume combining Xylography and MS. of the beginning of the fifteenth century; the Corser Block-book Apocalypse; two Caxtons; Gutenberg's Catholicon; the first book printed at Haarlem with a date; and three copies of Eliot's North-American Indian Bible.

Further considerable acquisitions followed: in July, 1873, for instance, he purchased the non-scientific portion of the Royal Society's Norfolk Library. A few weeks earlier he had acquired books and manuscripts to the value of £11,000 at the great Perkins sale. The total amount realised by the Perkins Collection was £25,000, so that nearly one-half fell to the bids of Mr. Quaritch. The accretions from those two sources enabled him to publish a special Catalogue, entitled "Bibliotheca Xylographica, Typographica, et Palæographica," in October, 1873. In this remarkable inventory the articles were respectively arranged under the headings of towns' and printers' names. The chronological sequence of Typography was followed, and nearly 1,300 works from the presses of the earlier printers in various countries, preceded by five Block-books, were described from examples actually in his possession. They included the Mazarine Bible (priced at 3,000 guineas); the Catholicon; the "R" Bible; Mentelin's Latin Bible; eight books printed by Peter Schœffer; a number of *editiones principes*; works from the press of Schweynheym and Pannartz; the Columbus letter; the first editions of Homer and Dante; a book printed by Colard Mansion; three works printed by Caxton; twenty-one by Wynken de Worde; and, in the Supplement at the end, a magnificent manuscript of Lydgate's "Siege of Troy." This wonderful "Bibliotheca" was, however, only one of a series, and was embodied in his large Catalogue issued in 1874, with alphabetical Index. The exceptional interest of the contents of that remarkable compilation will, perhaps, permanently distinguish it from most of his general Catalogues. It comprised a section devoted to Romances of Chivalry, old Works of Fiction, and popular books, united, classified, and grouped in a way unattempted by any other bookseller before or since. In its entirety this Catalogue consisted of 1,889 pages, of which the Index, in treble columns, occupied 109 pages. It has naturally proved a very attractive volume to a great number of book-lovers, and has found a place in all the important public libraries of the world.

The Preface to the 1874 Catalogue is interesting, as exhibiting some of the traits of character which distinguish Mr. Quaritch. He remarks that "no such Catalogue was ever before issued, and it is unlikely that it can ever be done again, owing to the increasing rarity of good old books, and the fact that, financially considered, the capital required to obtain such a large and expensive stock realises less than the percentage of profit readily secured by ordinary investment. Whether, further, any bookseller will be blessed with such uniform good-health, such universality of range in all branches of literature, and, I may add, such a devotion to his trade, time alone will tell. Anyhow, this Catalogue has been the greatest effort in my career as a bookseller, which now extends over forty years—twenty-seven of them on my own account." He concludes thus:—"It has been my endeavour

to make my establishment a focus for learned men and book-collectors of every sort, in which they may find, or readily obtain, anything they require, either to make a library or to follow up their literary and scientific pursuits."

Another large collection—that of Sir William Tite—was dispersed by auction in 1874. Mr. Quaritch's purchases on this occasion amounted to £9,500. The number of books bought then and at other sales since the issue of the General Catalogue of 1874, enabled him to prepare a "Supplemental Catalogue," nearly as large as the Catalogue which it "supplemented." It appeared in 1877, and consisted of 1,672 pages, of which the Index, in treble columns, absorbed 132 pages. The preface to this bulky volume stated that the General Catalogue and the Supplement together embraced, "in all, 44,324 articles—that is, not much under 200,000 volumes." Although he had become the owner of "the most valuable portion of Mr. Henry G. Bohn's remainder-stock," his intention was to devote the remainder of his life "to the retail business, the department in which I find the public most desires my services."

A great event in the world of Bibliophily occurred in 1878. We refer to the first Didot Sale, at which Mr. Quaritch was one of the principal buyers, and laid out 147,000 francs (£5,880). The second Didot Sale took place in 1879, and he made further purchases to the amount of nearly 143,000 francs (£5,720), and secured

MR. BERNARD QUARITCH.

some treasures of extraordinary value, including the "Talbot Prayer-Book"; an Apocalypse MS. of Castilian twelfth-century execution; and a fourteenth-century Apocalypse of Italian origin, each of unique interest. The result of these fresh acquisitions, and of a renewed inventory of old stock, was the issue in September, 1880, of his *magnum opus*, a Catalogue six inches and a half thick, containing 2,395 pages and describing 28,009 books; with an Index of 229 pages in treble columns, comprising between 75,000 and 80,000 references. Of a wonderful series of Catalogues it was by far the largest, and was intended to be the last. The extraordinary value of the books and manuscripts described, its enormous size and extent, and the copiousness of the Index, make it a veritable monument of bibliophily, bibliography, and typography, which will always be regarded by book-lovers with wonder and veneration. Yet while these lines are being put in print, another and still more colossal work of the same kind is nearly ready to make its appearance; and this, we can easily believe, must be the last. It will be, when completed, his *maximum opus*.

The year 1880 was big with two events which came into existence in 1881 and 1882, and which tasked to the utmost the energies and the resources of Mr. Quaritch, marking, indeed, the flood-tide of his career. The Duke of Marlborough and the Duke of Hamilton determined to exchange the grand inherited libraries of their lettered ancestors for gold and silver. The accumulations of antique learning which had been formed by the taste and knowledge of the first Earl of Sunderland between 1690 and 1720, augmented by the care of the second Duke

of Marlborough towards the middle of the last century; and the many thousands of beautiful volumes which had been gathered with such exquisite daintiness of selection by the author of "Vathek," with the few thousand books of elegant erudition which had been, during the first half of this century, added to Beckford's store by the tenth Duke of Hamilton,—all these were now to be swept away, unregretted by their owners. The sale of the Sunderland-Marlborough library occupied fifty-two days, ranging, at intervals, from December, 1881, to June, 1883. It realised over £56,000, of which Mr. Quaritch's contribution amounted to more than £32,000. The auction of the Beckford-Hamilton collection extended, at intervals, from June, 1882, to July, 1884, occupying altogether forty-nine days, and bringing a total result of over £85,000, a little more than half of that sum (between £44,000 and £45,000) representing Mr. Quaritch's purchases. The labour and difficulty of receiving, arranging, collating, distributing, cataloguing, and paying for the enormous acquisitions made during those two years and a half were enough to need a Hercules. The work was accomplished, however.

One might have supposed that no further effort was possible, but *noblesse oblige*; and, notwithstanding the exhaustion of resources and the plethoric condition induced by the great Sunderland, Beckford, and Hamilton sales, it was impossible for Mr. Quaritch to refrain from continued acquisition at the auctions of several important libraries during 1884, 1885, and 1886. His name is found as that of chief purchaser at the sale of the Syston Park books, December 12-20, 1884, at which his bill amounted to over £20,600, and included such extraordinary items as the Mazarine Bible (£3,900); the great Fust and Schœffer Psalter of 1459 (£4,950); a Block-book Apocalypse; the first edition of Caxton's "Mirrour of the World"; the first edition of the Greek Anthology on vellum; and the famous "Turrecremata," printed at Rome in 1473, containing the first Italian set of woodcuts. The Bible and the Psalter were additionally remarkable as having realised the highest prices ever paid for books. The former did not long remain in Mr. Quaritch's hands; the magnificent Psalter is still the most treasured ornament of his private library. Stimulated by the example of other great lords, the Earl of Jersey gave his library to auction in May, 1885, and again the principal buyer was Mr. Quaritch. His bill amounted to nearly £7,300, and comprised several Caxtons, of which the famous "Tale of Troy" (£1,820)—which was Caxton's first printed book, and the first book printed in the English language—and the "Mort d'Arthur"—the only perfect copy in existence (£1,950)—were the prime jewels. The other Caxtons were Tully's "Friendship," &c., the first edition of the "Mirrour," the "Gower," the "Eneid," and the "Dictes and Sayings" of 1477—the first book printed in England. Of the remaining articles, the most remarkable were the Coverdale Bible of 1535 (the only perfect copy of the book as published in England), the first Latin classic printed at Mentz (Cicero, "De Officiis," 1465), and the first edition of Dante (Jesi, 1472).—The Rev. John Fuller Russell followed next; his library was sold in June, 1885, and, during the five days of their dispersion, Mr. Quaritch bought a great many books of high intrinsic value and rarity, but none of excessive price. His bill amounted to over £6,000, and included three Caxtons, some of the minor issues of Gutenberg's Catholicon-press and several interesting liturgical and historical volumes printed in England in the sixteenth century. The sale in November, 1885, of the stock of Mr. F. C. Ellis, a London bookseller, in whom he had for many years recognised the only rival "worthy of his steel," compelled Mr. Quaritch to buy heavily, and again his bill reached a high figure—over £7,000. In June, 1886, the Woodhull library came to the hammer; it furnished the opportunity of buying MSS. of Thucydides and Livy, a couple of Dante MSS., a Catholicon, a first Homer, the first Aldine Virgil, the celebrated 1527 Boccaccio, some Grolier, Francis I., Henri II., and other bindings, and a variety of interesting volumes, all collected during the last century; Mr. Quaritch's bill for the ten days amounting to over £7,100. In the same month the small collection of choice MSS. which had belonged to Dr. Shadford Walker, of Liverpool, was sold, and an outlay of somewhat over £3,000 enabled Mr. Quaritch to enrich his stock with the Toggenburg Codex of 1411, the Perkins-Galitzin "Bible Historiée" of the fourteenth century, the Perkins-Galitzin "Roman de la Rose" of the fifteenth century, and several illuminated English and foreign MSS., chief amongst them for beauty being the Brégilles "Livre d'Heures," with grisaille miniatures executed at the court of Burgundy in 1442. In July, the Simes sale supplied him with many rare liturgical volumes of the Sarum and Anglican services printed in the sixteenth century, at a cost of over £2,200.

We have not taken note of several relatively minor sales, important in themselves, but overshadowed by those recorded above. Such were the Ouvry sale (rich in old English poetry) in 1882; that of the Drake library (rare Americana) in 1883; of Dr. Court's library of Americana, at Paris, 1884; of the Payne-Collier collection, 1884; of the Crossley library in 1885; and of the Addington collection in 1886. At all of these Mr. Quaritch took a prominent place as purchaser. The compilement of the Catalogue necessary to record such a vast number of acquisitions during six years has occupied a corresponding space of time and necessitated a great

expenditure of labour; each section being printed and issued separately when ready. The series proceeded according to his old system of classification, and it was decided to close the gigantic inventory with a second Catalogue of the MSS. and a final scheme of "Typographical Monuments." This last, which is to embrace the earlier productions of the press in all countries, will be completed in five sections, which are to form the seventh volume or division of a colossal "General Catalogue" (begun late in 1880 and ending in 1887); with an alphabetical Index on a similar scale appended. Among the supplementary additions to be found in these terminal parts will be the detailed record of purchases made at the sale of the late Baron Seillière's library (February 28 to March 4, 1887). The collection was very rich in books of old romantic literature, Spanish, French, Italian, and German and included, besides many other volumes of exceptional interest, the unique copy of the first edition of "Amadis," and the first edition of the famous Catalan romance, "Tirant lo Blanch." Both of these fell into Mr. Quaritch's hands, along with a Parisian MS. missal (XIVth century) of unrivalled beauty, and several other items of great value; the total amount of his bill being nearly £8,000. The work of cataloguing is approaching its termination, and will be finished this year. Mr. Quaritch will then be able to say, *Exegi monumentum*, and win the chance of indulging for a while in that leisure which most men seek at an earlier period of their lives, and which has hitherto been denied to him.

When we reflect on the work he has accomplished, on the unique position he has created for himself, and remember his obscure position as a young stranger in London forty-five years ago, we wonder at the indomitable will, the unwearied perseverance, and the mental vigour of the man. It is just forty years since, when leaving Mr. Bohn's service, he uttered a phrase which must then have sounded absurd, but which time has verified:—"Mr. Bohn, you are the first bookseller in England, but I mean to be the first bookseller in Europe!"

Messrs. A. & W. Flatau & Co., London and Northampton.

OTHING could better illustrate the enormous development which has taken place in the application of machinery to manufacture, since the Queen's accession, than the progress of the boot and shoe manufacturing industry during the past fifty years. Half a century ago, no such thing as a machine was heard of in unison with the manufacture of boots and shoes; now, throughout the entire process, machinery of the most ingenious description is employed, and hand labour is only required to tend the machines and supplement their work. Instead of the solitary cobbler "sticking to his last," as the old proverb taught him to do, one sees in a modern well-organised shoe-factory scores of busy men and women attending to the various machines for lasting, riveting, heeling, sewing on the soles, and finishing; and such is the intelligence with which the whole system is planned and managed that each employé in the establishment is working into the hands of all the others.

As a typical specimen of a first-class boot and shoe factory, we cannot do better than take the works of Messrs. A. & W. Flatau & Co.; and the mention of this Firm in this connexion is the more appropriate that their business was founded close upon half a century ago, or just about the time when the Queen ascended the throne. At that time, everything being produced by hand labour, in the homes of the operatives, there was actually no such institution as a boot *factory* proper; but now hand labour has been superseded in every department either partially or wholly by elaborate mechanical appliances. Were this not the case it would be impossible to contend successfully against the protective duties which most foreign countries and even our own colonies impose on imported goods. These duties necessarily tend to restrict to some extent the sale of English-made boots and shoes abroad; but such is the excellence of the system by which every scrap of leather is utilised in these works, and so careful are the gentlemen at the head of the concern to test every newly-invented labour-saving machine with a view to its introduction if it give satisfaction, that Messrs. Flatau & Co.'s goods find a market in every part of the globe, not even excepting the principal shoe-producing centres of the Continent, where labour is so much cheaper than in England. A labour-saving machine, that gives satisfaction when tested, is at once adopted, and very frequently is improved upon also by the Firm's engineers. Yet, with all this attention to economy of labour, the operations of Messrs. Flatau & Co. are conducted on so large a scale, that some fifteen hundred workpeople are employed in their various establishments, either attending to machinery or performing other duties which even the most ingenious machinery cannot perform. It is gratifying to learn that the revolution which has been brought about in this branch of manufacture by the introduction of modern inventions has been attended, not by a

decrease, but by an increase in the wage-earning power of the operatives, who, in these stupendous workshops, present a striking contrast to the shoemakers of olden times, and of districts where the want of capital and modern inventions has left old systems unaltered. The workshops, it should be mentioned, have been built with a view, not only to economy of labour, but also to the comfort of the hundreds of human beings who pass so considerable a portion of their lives within them.

Mr. Abraham Flatau, the father of the present partners in the Firm, was the founder of the business, which, from a comparatively small beginning, has steadily worked its way up to its present leading position in the trade. Constant and intelligent regard for the requirements of every market to which the Firm's products find their way, and a determination not to sacrifice quality for anything, have been among the principal causes

WORKS, ROPEMAKER STREET, FINSBURY.

of the success of this enterprise. In the sample-room one finds admirably arranged for immediate reference and easy inspection samples of every make, fashion, and quality for all quarters of the world. As may be supposed, different countries have specific peculiarities. Here is a boot with finely-arched instep specially adapted for the use of the South American; there is one, elaborately ornamented, designed to please the native of India; here is a sensible foot-covering for the colonist of British North America; and there is one for his cousin in

SYDNEY AVENUE FACTORY.

NORTHAMPTON FACTORY.

Australia and Cape Colony. The wearing qualities of the goods turned out from these workshops are now known in even the most distant countries; and the buyers of the very cheapest of the boots cannot but admit that their purchases are characterised in a remarkable degree by elegance and finish. Messrs. Flatau & Co.'s endeavours to turn out the best goods have been rewarded by numerous successes at Exhibitions in various countries; indeed, they have gained prize medals at almost all the leading Exhibitions since 1851. They have at the present time the largest boot and shoe manufacturing business in London.

The largest of the illustrations above represents the principal factory and offices in Ropemaker Street, Finsbury, which was built some twenty years ago. This was supplemented by a second factory in Sydney Avenue, Milton Street, almost as large, devoted to the production of the lighter goods, such as those for ladies and children. Another factory, situated at Northampton, is occupied with turning out stronger goods,

such as boots and shoes for army purposes, and for men's wear generally. We give illustrations of the Sydney Avenue and Northampton factories as well as of the head-quarters in Ropemaker Street, Finsbury.

Every one knows the old saying, "There's nothing like leather"; but Messrs. Flatau & Co. are determined to show that even this old saying must, in these days, be accepted with some reserve. They have been bringing their intelligence and perseverance to bear on a new chemical compound, which has been dubbed "Dermatine," and which, after endless experiments, they have successfully applied to the manufacture of the soles of shoes. The new material has already been extensively tested, and is found to outwear any leather sole. It is now being introduced to the public in some of the most elegant articles of foot-gear that can be produced.

Mr. Jacob Flatau, who is the present head of the Firm, takes an active part in the conduct of this enormous business, but, nevertheless, devotes a considerable amount of time to every public movement calculated to advance the status and interest of the trade. He was mainly instrumental in founding the Association of Boot and Shoe Manufacturers, and is Chairman of the Committee of Management. This association has been of considerable benefit to the trade, and is now engaged in the most useful work of providing technical schools for members of the craft. With the help of such schools it may be hoped that England will maintain her pre-eminence in this branch of manufacture, which, although it may not be generally known, is quite one of the leading industries of the country.

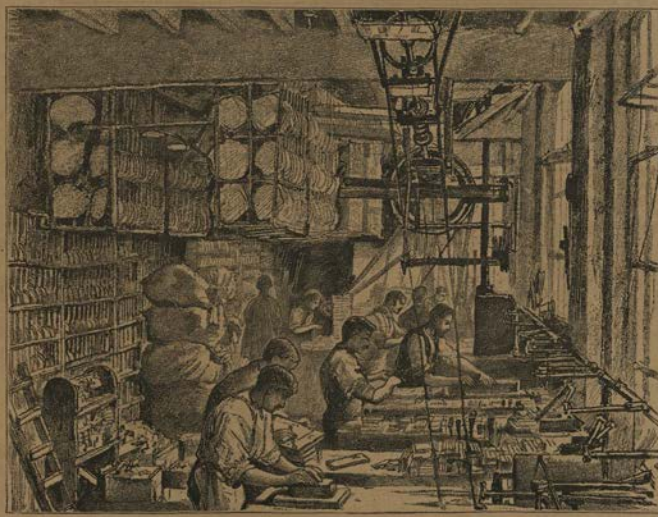
Mr. E. Badoureau, London.

THE accompanying illustration depicts the interior of one of the workshops of Mr. E. Badoureau's Boxwood Block Manufactory, the largest in London, and, we believe, in the world; and we purpose to give a few details, which we think will prove of interest to many, of the process employed for obtaining the large surface-blocks which are now required for illustrations in books, pictorial papers, and, in many instances, for advertising purposes. The blocks are made from the hard wood of the boxwood-tree, called *Buxus sempervirens*, from the species of the *Buxaceæ*. It grows in this country like a shrub, being an evergreen, in foliage and substance similar to the miniature box borders which are used to a great extent in our own gardens; it does not, however, attain to any great size in northern latitudes, but in eastern countries, especially Turkey, Persia, and the south of Russia, it grows to a height of from 25 feet to 30 feet, and sometimes measures as much as 12 inches to 14 inches in diameter.

Boxwood appears to have been little known as an article of commerce before the present century, although it had been previously used as a sudorific. Small lots were sometimes forwarded by Smyrna merchants to this country, but the wood was principally used for furniture, caskets, rules, scales, &c. Constantinople was originally the principal port for export, and the trade was entirely in the hands of Turkish merchants, although the chief source of supply was Russia, which also yielded the best quality. It is only recently that our countrymen have monopolised the markets of Europe for this wood, and nearly all the Boxwood now comes into Liverpool from Poti, in the south of Russia, whereas formerly it went to Marseilles. Of late years the governments of the countries whence it is drawn, afraid of its extinction by an ever-increasing demand, have, by charging heavy export duties, and placing so many restrictions—in some contracts, even, making it obligatory on contractors to open up roads into the interior of the forests—virtually closed some of them. It is to these restrictions that its enhanced value in this country is partly due, good sound logs, at the present time, not being procurable at less than £30 to £40 per ton; and, taking into consideration that more than one-third is sawn up as waste, none of the outside being of any use, it will be readily understood that the cost of producing blocks suitable for engraving purposes appears, at first sight, somewhat expensive. To procure the logs in perfect condition care should be taken to fell the trees in the autumn, just as the sap is running down, thereby securing the finest-grained and best-coloured woods. After the tree is felled it is cut up into convenient lengths and strapped on the backs of horses, each carrying from 3 cwt. to 4 cwt. In some instances it has to be conveyed many miles across country, a journey which is attended by many difficulties and even peril, men and horses having sometimes to swim rivers to reach the nearest port of shipment; and it not infrequently occurs that horses and load fall together down some of the

numerous precipices in the mountains which have to be crossed, and are left to be devoured by the wolves which abound in those regions.

On arrival in this country the logs are generally, in the first instance, stored in sheds so that neither the sun nor wind shall damage their colour or texture. When required for use the logs are cut up into rounds of about an inch in thickness, and are then placed in racks, as shown in our illustration, for the purpose of drying, a process which takes from one to three years, according to the temperature of the drying-room. When the rounds are thoroughly dried and well seasoned, they are squared into sizes as large as the size of the rounds will admit; the squares are then matched according to colour, and subjected to a further process of drying. When sufficiently dried the pieces are planed up, drilled for bolts, grooved, and fastened together either by wooden tongues or brass bolts, the surface put on, and the blocks reduced to the



INTERIOR OF WORKSHOP.

proper height (viz., type-high), and squared up to size required. Machinery is largely employed in the preparation of the wood, and it has been so improved of late years that the blocks, after passing from one machine to another, on leaving the last machine the only manual operation necessary is to glue or bolt them together and put on a finishing polish. The object of using so much machinery is not so much to dispense with hand labour, although it sensibly decreases the cost of production, as to ensure a perfect uniformity in each section, which is absolutely necessary for the perfect joining of the blocks. The advantage of having a block bolted together with brass bolts and screws is, that after the drawing or photograph has been obtained on the wood, the block can be taken to pieces, and given out to any number of engravers to engrave, who return the sections, which are again screwed up together, thus enabling a dozen or twenty people to work on one block at the same time, where formerly only one could be employed—the saving of time being of paramount importance in the production of prints. Many double-page views or panoramas are made

up of from forty to one hundred pieces, and this minute subdivision of an engraving is the secret of the way in which it is possible to illustrate an event which very often occurred only a day or two before the issue of a publication like, for instance, the *Graphic* and *Illustrated London News*. Without this subdivision of the block into so many pieces, it would take months to engrave a single view. With large bolted blocks, the first care of the chief engraver is to cut or set the lines across the joins before the different parts are distributed to the engravers. This operation, as may be supposed, requires skill, as the effect of the entire picture depends, in a great measure, on the joins, which give the key to the lights and shades of the whole block, as each engraver with his piece has to follow the tone of his join.

In photographing a drawing on the wood, the photographer should be careful not to saturate the block with water, and, after putting on the white coat, to let the block remain in an upright position to allow the water to pass through the fibres of the wood; a good plan is to damp the back of the wood a little to counteract the effect on the face. The moisture being absorbed by the wood by capillary attraction, the pores of the wood become dilated, and sometimes, when the wood is too dry, it warps on the face. It is advisable to keep all blocks in an upright position, especially if they are packed away in any damp place, though, of course, this should be avoided if possible.

Latterly, process work, such as zinco, etching, &c., has superseded the art of wood engraving for cheap advertising purposes; but there is no doubt that those who have used much of this work are gradually reverting to the old and better plan of having a good woodcut, taking electrotypes from the block, and keeping the woodcut as matrix, which is much cheaper in the end.

FINE ART ELECTROTYPE AND STEREOTYPE DEPARTMENT.—We will now suppose that one of Mr. Badoureau's boxwood blocks is returned to him, after it has been engraved upon, for the purpose of having an electrotype taken; the block is first thoroughly cleaned to remove any ink that may remain after taking proofs. A composition chiefly consisting of beeswax is poured into shallow metal pans and allowed to cool to a certain temperature, the surface is then carefully brushed over with plumbago with a soft brush, the wood engraving is also brushed over with plumbago and placed upon the composition and subjected to hydraulic pressure. When the block is removed it will be seen that the finest lines are reproduced in relief in the composition, which we will now call a mould, and which has to be again polished with plumbago to give it a more conductable surface, and then hung in a tank, or technically speaking a bath, containing a solution of sulphate of copper.

Before proceeding further, it is necessary to give a short explanation of electro-metallurgy, so far as it relates to the present mode of electrotyping. It is the art of depositing copper by solution upon or into moulds or models, and many beautiful reproductions of art workmanship have been produced by this agency, and with the aid of electricity, which is generated by means of various batteries and dynamo-machines. But perhaps the most important and useful application of the art is that which enables the printer to multiply his printing surfaces, whether of ordinary type, zinc etchings, steel and copper-plates, or engravings on wood. Many operators prefer the form of battery invented by Dr. Alfred Smee, which consists of a sheet of platinised silver placed between two plates of zinc previously amalgamated with mercury in a diluted solution of sulphuric acid; this battery is placed by the side of the tank containing the solution of copper. On one side of the tank are two copper rods, one connected to the silver of the battery, and the other to the zinc plates; across the tank short copper rods are placed in sets of three, from the centre rod is suspended a sheet of copper which is connected to the rod leading to the silver of the battery; on the two outer are hung the moulds which have to be connected to the rod leading to the zinc plates, the action taking place immediately, and in a short time a film of copper is projected on to the mould. A sufficient coating of copper can now be deposited in four hours for ordinary printing purposes, but, of course, the longer it remains in the battery the better, as the shell of copper will be thicker, and will stand the finishing and printing with much greater advantage than the thin shell. The coating or shell of copper is now taken off the mould by pouring hot water upon it, which enables it to be easily removed; the shell is then placed in an iron pan, and metal, composed of lead and antimony in certain proportions, is poured upon the shell to the required thickness; when cold, it is taken out of the pan and the surface cleaned with emery powder and turpentine, it is then levelled on a smooth steel slab, and placed first in a lathe, then in a planing machine, to take off the surplus metal, and finally screwed or pinned on mahogany, and planed to the height of type, that being the standard gauge. We have now a facsimile in copper of the engraver's wood block, thus enabling publishers or printers to keep the original wood engraving to produce sharp electros from whenever wanted, or to put a number on one machine at once when any printing is required in a hurry. The cost of an electro is a mere trifle in comparison to the

original cost of a wood block. Sometimes the electros are required to be printed in colour; when that is the case it is necessary to protect the face of the electro by silver or nickel plating, or brass or steel facing, as without this precaution the mercury in the coloured inks corrodes the copper. The plating, &c., is also done at the above-mentioned establishment.

Stereotyping is another and older method of producing duplicate printing surfaces, and an entirely different process, distinguished from electrotyping by its being purely mechanical and very simple, whereas electrotyping is scientific and needs great care in each of the many different processes the electrotype has to undergo before it is finished. In stereotyping, the first process is to take some ordinary brown, blotting, and tissue paper, then some paste that has been specially prepared, and paste the three kinds of paper together; the form of type that has to be stereotyped is then oiled and the pasted pieces of paper placed on the face of the type and beaten in with a large stiff brush; when beaten in sufficiently more paper is pasted on to strengthen it, and it is then put under a hot press and dried; when dry it is taken off the form and laid on a hot steel surface with steel gauges the thickness of pica—about 1-6th of an inch—placed round it, and another hot steel surface placed upon them, thus forming a box into which metal is poured, which is almost similar to that used for backing up electrotypes, the only difference being more antimony to make it harder when the metal is set. The box is opened and the metal plate taken out, leaving the mould still in the box for another cast to be taken if necessary. As many as twenty casts are sometimes taken off one paper mould, each cast being an exact reproduction of the form. The same process has then to be gone through of planing and mounting them as has been already explained in the short account of electrotyping.

Messrs. William Tonks & Sons, Birmingham.

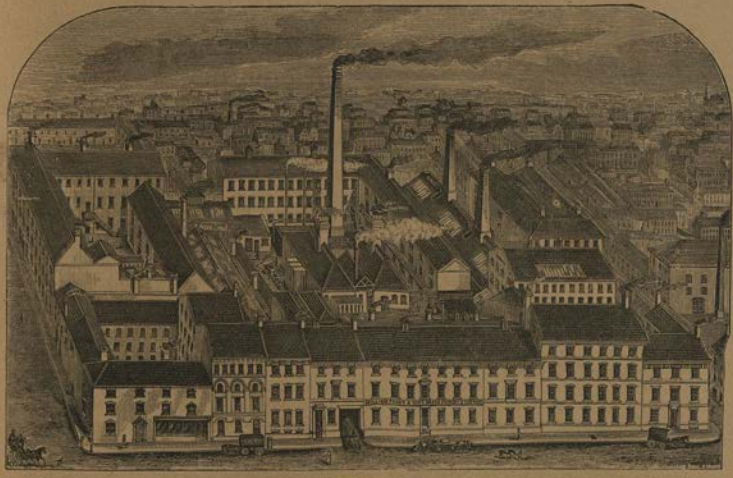
WHAT Manchester is in connexion with the Cotton trade, Bradford in the Woollen branch, Sheffield in the Steel industry, that Birmingham is in relation to the Brassfoundry trades. Her manufactures are met with everywhere; in our homes they confront us on every hand, either in the form of useful appliances or in the shape of ornaments; on railways and on steamboats; in the Queen's Palace and in the peasant's cottage; in our Art Galleries and Public Museums; in our churches and in our theatres; in the huge factory and the busy counting-house; wherever we are, we meet with some example of Birmingham manufacture; and it is not too much to say that, sleeping or waking, from the cradle to the grave, we are dependent upon the productions of Birmingham for much of our comfort and many of our luxuries. Bold as this assertion seems, it is nevertheless literally true, and this universal dependency of mankind upon her manufactures has insured for the good old town a world-wide fame.

Probably few persons outside Birmingham realise the diversity of her productions. We shall, doubtless, be within the mark when we say that, at a rough computation, some 800 distinct trades are carried on there. In the Brassfoundry Trade alone the number of various articles made may be numbered, not by hundreds, but by thousands. To single out a particular Firm whose manufactures embrace a large proportion of the goods referred to, we may take that of Messrs. William Tonks & Sons. Their factory in Moseley Street is illustrated on the next page, and, large as are their premises, the accompanying "cut" does not convey an adequate idea of the extent of the business carried on therein. The Firm in question will shortly celebrate the centenary of its existence, and it is a somewhat exceptional feature in its history that the concern has, from its origin down to this day, been always owned and managed by a member of the same family. The present partners are Mr. William Henry Tonks and his brother, Mr. Edmund Tonks, both of them gentlemen who have extended their interest beyond the range of their business, and have taken an active part in the promotion of every public movement that could conduce to the general welfare of their fellow-townsmen, whose personal esteem they have thus secured.

The business was established at a time when the Brassfoundry industry was just about emerging from a slow-going, unpretentious trade into an important branch of manufacture. Messrs. Tonks's enterprise, we may say at the outset, has more than kept pace with the development of the trade as a whole. Their Works have been planned with the object of being, in the main, independent of outside help. For instance, much of the machinery that is used, not excepting some of the steam-engines, has been built on the premises, while the dies and patterns employed are also made on the spot. This system of concentration is conducive to the general smooth-working of the business, and also greatly facilitates the prompt execution of orders, since whatever may be required, even if quite outside the ordinary range of goods, the resources of the establishment are fully equal to the supply of any such exceptional demands.

Commencing our brief survey of the Works, we pass first through the Engine-room and Fitting-shops, which latter, under the circumstances before referred to, form an essential feature of the factory. Following the manufacturing processes in their logical sequence, we proceed next to the Pattern-making Department—a portion of the factory of first importance, since upon the artistic character and manipulative skill here shown depends much of the subsequent success of the work. Near this department are the Pattern-rooms, and a glance round the shelves, drawers, nests, &c., fitted up in each room brings home to one the bewildering variety of goods made. Some 30,000, or even more, patterns are here stowed away, and yet so perfect is the system of classification and registration adopted, that any desired pattern, core, stock, or mould can be found almost at a moment's notice. In passing through these rooms, one cannot help thinking of the fortune which must have been sunk in the production of this endless array of patterns.

Apart from the ordinary branches of work, Messrs. Tonks also make on the premises all the brass used



MOSELEY STREET WORKS.

in their casting-shops. By this means is insured a uniformly high quality, as none but the best brands of metals are employed in its composition. This work is carried on in the Mixing-shop, where a number of air-furnaces are devoted to smelting. The metal is mixed in plumbago crucibles, from which it is emptied, while in a liquid state, into moulds, thus forming the brass ingots of commerce.

The preparation of the moulds for the article to be manufactured is the next step. The wrought-iron moulding-frames used are formed of two halves. The first half of the box is filled with sand of a special quality, and the patterns are then inserted; if of a circular form, they are driven into the sand down to half their diameter. After dry parting sand has been rubbed over the surface of the first half of the box, the second, or upper, half is dropped on and fixed. This, too, is then filled with sand, which is beaten down to insure that every crevice shall be filled. A moulding-board is now placed on the back, and the two halves of the box are then separated. The pattern is now lifted out, and what are termed "gets" are formed in the sand, viz., channels which are connected with the apertures provided at the side of the casting-box for the

introduction of the molten metal. Of course, the kind of sand employed varies, according to the quality of the castings to be produced, as does also the amount of pains taken in the preparation of the moulds; but the above is in all essentials the process generally followed. The metal is then poured in through the apertures before mentioned, and shortly after the two halves of the box are separated and the brass castings taken out. In this connexion it may be mentioned that whatever articles of ironfoundry are required are also cast here, by which means a better quality of work is secured than would be obtainable otherwise. There are, altogether, ten Casting-shops, some of them having, moreover, double pots, which fact may be taken as evidence of the immense number of castings here produced.

The castings are next taken to the so-called "Shaking-barrels," by the action of which all sand adhering to them is removed; and from here they are passed on to the Rough Warehouses, where they are readily sorted by a number of women, who would appear to class each article as if it were by instinct. As indicative of the scale on which production is carried on, it is worth recording that over fifty tons of castings are generally stored in these warehouses. Adjoining are separate Stock-rooms for metal ingots and for china and glass fittings, such as knobs, handles, finger-plates, &c.

Before following the cast articles further in their process of manufacture, allusion should be made to the Tube-drawing Mills, since in this branch Messrs. Tonks have for many years held an unassailable position. There is an immense consumption of brass in the form of tubes, and it is applied to an almost endless variety of purposes, many of which will suggest themselves to any one who looks merely round his own home. In addition to all the ordinary contrivances brought into requisition for the production of the various classes of brass tubing made, such as revolving shears for cutting the metal, rolls, draw-benches, &c., Messrs. Tonks have in operation a special machine for "floating" tubes. This is brought into requisition after the two seams or edges of the tube have been jointed together by the aid of brass solder. Under the old process the tube was, when in this state, filed by hand, and the Firm under notice were the first to introduce the ingenious apparatus referred to. The floating-machine is automatic in its operation, and after the tube has been attached to the horizontal bed, the "floats" begin to give the finishing touches to the tube, and this is done in a manner far superior to what could possibly be attained by hand labour, there being not a tool-mark left when the work is completed.

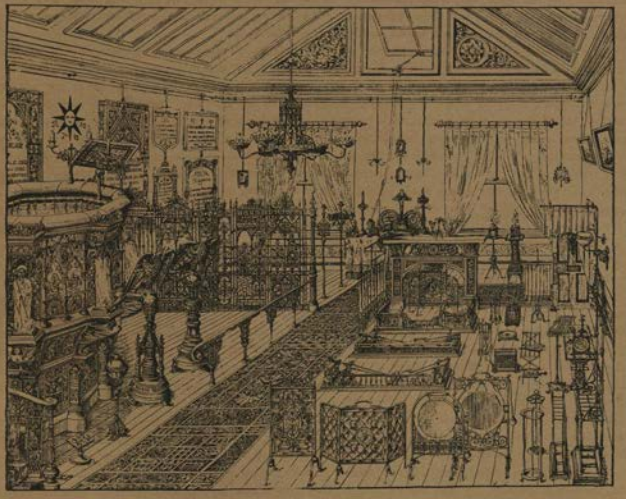
Brass Stamping forms yet another branch of the business, and several rooms are set apart for the purpose, and many others for Press-work. The powerful machinery in these is set in motion by a steam-engine located near, which was constructed by the Firm themselves. The Finishing-shops, twenty-two in number, next engage attention. The diversity of finishing processes here carried on is too great to allow of any intelligible description. Suffice it to say that all are fitted up with the most improved appliances, and that the visitor in passing through these rooms is enabled to judge of the endless diversity of brass goods produced. "Dipping," polishing, and lacquering complete the manufacturing processes, and separate workshops are devoted to each of these operations.

Interesting as it is to watch the various stages of manufacture through the long range of workshops, it is only when the commodious Show-room is reached that one begins fairly to realise the extent of the business and the diversity of the productions. We can, within the space at our disposal, enumerate only very few of these latter. To commence with some of the minor articles which are the Firm's patented specialties. These include Bookshelf Fittings, by the aid of which the shelves can be adjusted to any desired height. The slots in the metal strips, which are fixed inside the bookcase, are close to one another, so that the supporting projection can be easily raised or lowered as may be desired. These patent fittings have been adopted for most of our Public Libraries built within the last few years, while they are also employed by many of the leading library-furniture makers. The Firm's patent sash-guard is all that it professes; since it effectively resists all attempts made from outside to push it back. The Patent Keyed Door Furniture is so contrived that the knobs do not work loose and become detached, but, once fixed, they can be depended upon as being thoroughly secure. Messrs. Tonks's patent sash-opener and automatic sash-fastener is equally worthy of commendation. This fastener secures the window most effectively both when partially open or closed. Being self-acting, its working and safety are not jeopardised by a careless or forgetful servant. It is altogether self-contained, and strongly made, so that it cannot get out of order. Wethered's patent Blind Furniture is also a very ingenious contrivance. Most of us are familiar with another of the Firm's specialties, viz., Hookham's patent picture-line and fasteners, which have for a long time past demonstrated their great strength and usefulness.

Without having by any means exhausted the list of patented appliances, we must pass on to mention a

few of the other classes of goods here manufactured. These include many tasteful designs in fenders, fire-dogs, and brasses; also candelabra, sconces, and wall-mirrors of beautiful pattern. In fire-screens there is a charming variety, many of them enriched with delicately-tinted and stained glass. Electric and ordinary bell furniture is also made in many styles, as well as cornice-poles, gong-stands and gongs, umbrella-stands, fire-guards, plain and ornamental stair and picture rods, and a host of other things, large and small, which are used in the building, furnishing, and fitting-up of houses, churches, public buildings, &c. But even this generalisation does not express the diversity of the Firm's business operations, for they do also a large trade as Naval Brassfounders, and what this implies can perhaps only be realised by those who, during a sea voyage, have looked closely into the fittings, &c., used in the construction of a fair-sized steamer.

About half a century has elapsed since the art of Ecclesiastical Metal-Working was revived in this



SHOW-ROOM.

country. Much thought and original research have been brought to bear upon the subject, and as an outcome, the various materials employed are now manipulated in accordance with their several special requirements. Both form and construction have undergone a thorough change, while carefully-studied geometric ornament has taken the place of the nondescript florid style previously in vogue.

Among the Firms that have since then engaged in the manufacture of Mediæval or Ecclesiastical Metal-work is that of Messrs. William Tonks & Sons, to whose general branches of brass-foundry we have already drawn attention. We give above a general view of their Birmingham Show-room. It will be observed that pulpits, lecterns, altar-rails, coronæ, church-lamps, chancel-screens, and similar articles for church furnishing and ecclesiastical use, are included in the display.

We may point out that some of the best traditions of the Mediæval metal-worker have been successfully revived by this Firm. The designs of the brass lecterns, gas-standards, coronæ, and other accessories are

chaste and of a suitable character. The various processes of casting, hammering, stamping, pressing, and die-work, are all brought into requisition for this branch of metal-work, much the same as for that previously described. In many descriptions of work the greatest skill is, moreover, required to produce such articles as shall be in harmony with the architectural character of the particular church for which the several items may be intended. Crucifixes, candlesticks, sanctuary-lamps, and a number of similar articles of church furniture are also produced here. Many of these are of an elaborate character, and others are characterised by a more severe treatment. As a rule, however, Mediæval principles of construction have been adhered to, although adaptation to modern requirements has been duly studied.

Prize Medals have again and again fallen to the Firm's share whenever they have thought it worth while to put in an appearance at International Exhibitions, from that of 1851 downwards, and their handsome Catalogue of more than 800 pages will tell better than any words of ours the truly endless diversity of their manufactures.

After having thus passed in brief review some few of the productions of Messrs. William Tonks & Sons, it will be seen that their business is one that well deserves a place in these pages. The two brothers who have now for many years been at the head of affairs have, in their management of the concern, shown qualities which could not fail to have commanded success in any sphere of life. They have brought rare skill and taste to bear upon their work; they have ever sought to meet the special requirements of their customers; and, progressing with the times, they have endeavoured, and not unsuccessfully, to adapt their goods to the tastes of foreign nations, while at the same time trying to induce their own countrymen to appreciate in Brass furnishing goods what is truly excellent in design and workmanship.

Messrs. J. & B. Stevenson, Glasgow and London.

THOSE who have lived for any length of time in London, unless they have been exceptionally fortunate, must be painfully aware that London bread is by no means always as pure and well manufactured as it should be. From time to time the wrath of the Londoner is excited on the subject, and very unpleasant things are said and written about the unwholesome surroundings and arrangements of the ordinary London bakehouse. Generally it is placed somewhere underground, well away from the reach either of light or pure air, and frequently containing, or in close proximity to, an open drain, whence it receives whatever foul air, vermin, or other unsavoury substances may chance to visit the place. Notwithstanding that this is a matter of common knowledge, such things are still, to a large extent, permitted to go on unchallenged, so far as the voice of the public is concerned. That reform in the needful direction can be successfully accomplished may be readily demonstrated by comparing an average sample of London bread with an average sample of the same article manufactured, say, at Dublin or Glasgow. The former has an unclean look when cut, is destitute of fibre, and easily crumbles, and unless consumed on the day it is made, or, at latest, the day following, is considered in many instances, unfit for use; whereas the latter, which has obtained a very high reputation, is of an almost faultless white, shows a splendid fibre, and retains its softness and flavour for an indefinite time; indeed, the ordinary two-pound loaf in common use in Glasgow has more than once been enjoyed on the other side of the Atlantic. In no small degree this condition of affairs, so favourable to the Glasgow public, is due to the skill and enterprise of the Firm whose establishments we are about to describe.

It is now nearly twenty-two years since this Firm was established in Glasgow. Their first venture was a comparatively small one, although at the time regarded by members of the baking trade as too large an undertaking for a Firm just beginning. The original premises, which were at Cranstonhill, in the immediate neighbourhood of the bakeries now known by that name, contained but five ovens of the ordinary Scotch type, and the other appliances were in proportion; but these premises, unlike most other bakehouses, were specially planned and erected for the purpose of turning out as fine a loaf as it was possible to produce,—under the most favourable sanitary conditions,—they were furnished with the most approved appliances of the time, and everything that experience could suggest was effected in order to make the accommodation as complete and perfect as possible. The same care and attention that were given to the minutest details of the building and plant characterised the process of manufacture and the methods of handling and distribution, in every department, from the preparation of the barm till the bread was put on the shelves of the retailer. All this care and skill, combined with the determination of the Firm to use nothing but the finest descriptions of pure wheaten flour, resulted in the production of such a loaf as commanded the appreciation of the public. Consequently it soon became necessary to make first one extension and then another, until, in 1878, the

present Cranstonhill Bakeries were erected, with the conviction that at last it would be possible to meet the growing demands of the public for many a long day. These bakeries comprise a solid block of seven storeys, floored throughout with brick, and concrete arches resting on massive iron beams. They contain, in all, thirty-six ordinary and one large revolving oven. Here, too, however, the accommodation for the constantly-increasing trade soon became altogether insufficient, and, in 1882, the establishment at Plantation, on the south side of the river, was put into operation. These two concerns form, perhaps, the largest and most completely-equipped bread bakeries to be found anywhere, and together are capable of turning out 100,000 two-pound loaves each day. Externally they resemble wool-spinning factories or cotton-mills in point of size, although, unlike such establishments, men only are employed as operatives. The lower floors in each case are devoted to bakehouse work proper, while in the upper portion of the buildings accommodation is provided for the storage of many thousand sacks of flour. The first thing that strikes one on entering either of the bakeries is the ample space that is allowed in all departments and for every operation. The various bakehouses which, as we have said, rest on floors of solid brick and concrete, are finished with a paving

CRANSTONHILL BAKERY.

of grated ironwork levelled off with Portland cement; this floor offers, at the same time, a smooth, hard surface, along which the immense tubs can be easily pulled, and is able to resist the consequent tear and wear. The ovens, of which there are from nine to fifteen on each floor, are mostly double, and are placed along one side, from end to end, of the bakehouse. The soles and "cuist" stones of these ovens, like those in most Scotch, and in many modern English and Irish bakeries, are from the famous Duntonknoll Quarries near Irvine. This stone has a peculiar tendency to retain the heat and to equalise the temperature, and is very durable. Running along the centre of each bakehouse are the "moulding"-tables, amply provided underneath with substantial and convenient "prooving"-cases. On the side opposite to the ovens are the various "doughing-machines," stirrers, and other steam appliances, wrought either by separate small engines or driven by belting from shafting running directly overhead. Spacious barm-rooms are provided for each bakehouse or floor, and are furnished with apparatus whereby the temperature can be regulated as required. Work begins in these factories at ten o'clock at night, but only a small proportion of the men come in to work at that hour. The majority of the operative bakers start work at two in the morning; by noon, or shortly thereafter, the work is done, the workers with one or two exceptions are gone, and the bakehouses

and machines have all been cleaned in preparation for the next day's work. This is in striking contrast to the way things are conducted in a small London bakery. Not only are the results much more satisfactory to the public who consume the bread, but the workers have a less wearisome and exhausting task than the employés of the small London baker with his endless round of drudgery. In the main front of each of these bakeries is situated the bread-room, a spacious and lofty hall lined all round with glazed white brick, and fitted with the necessary shelving, racks, and counters. Here six large four-wheeled vans can be loaded simultaneously with order and rapidity. In addition to the business done by the vanmen in and around the city, numberless hampers and cases are sent off by rail and river to some of the remotest parts of Scotland. Accommodation for the vans and horses is provided in a separate building, of which the ground-level is reserved for the vans, the horses being lodged upstairs on a first or second floor, as the case may be.

PLANTATION BAKERY.

In October, 1885, Messrs. J. & B. Stevenson opened their latest venture, namely, the Battersea Bakeries, situated in Park Road, London, S.W. These London Bakeries, constructed on similar lines to those of the same Firm in Glasgow, are not conducted on entirely the same plan; the two older establishments are for loaf bread alone and do only a wholesale business, whereas the London one is for retail business, and produces not only bread of the first quality in every variety, but also short-bread, biscuits, all descriptions of tea and fancy bread, pastries and cakes, including wedding and christening cakes. The Battersea premises, being situated near the Thames, have the advantage of excellent wharfage facilities. The flour is brought up the river in barges, and from these is hoisted direct into the stores. All flour is carefully sifted before being used. Sufficient space has been secured in Park Road to allow for enormous extension, and already arrangements are being completed for a considerable enlargement of oven and storage accommodation. For the benefit of Londoners who do not live at Battersea, the Firm are opening depôts all over the Metropolis; already depôts have been opened at 20, Edgware Road, W., 153, Fenchurch Street, E.C., 64, King William Street, E.C.,

256, Oxford Street, W., 234, Upper Street, Islington, N., and 500, Brixton Road, S.W., and as occasion offers these will be indefinitely multiplied. In addition to these branches, vans to the number of several dozen are daily at work delivering the goods at the doors of customers. The success that has so long attended the Glasgow business of this Firm, and is now following the London concern, is due, undoubtedly, to the entire freedom of the bread from all adulteration, and to the scrupulous cleanliness, orderliness, and care

BATTERSEA STEAM BAKERY.

with which all the operations are conducted. To such perfection have this Firm brought their bread by the means already described, that they sometimes find it difficult to convince the people of London that nothing is mixed with the legitimate materials to give so much whiteness to the loaf. Any one, however, who is sceptical as to the degree of whiteness which can be secured by such means alone as we have mentioned should pay a visit to one or other of these bakeries and see the whole process of breadmaking for himself.

Messrs. T. & T. Vicars, Liverpool.

TURN to what departments of manufacture we will, we look in vain for the survival of the old hand-making methods. In every branch of industrial activity we find that mechanical appliances take the place of manual labour, and engineering science to be a ceaselessly active agent, whose dogmas of economy revolutionise the world of thought and practice. Through its instrumentality alone must the inexorable laws of supply and demand be satisfied; and do we yet haply discover an old-time trade which has refused to re-shape itself in unison with the evolutionary doctrines of the day, that trade, whatever may have been its importance and glory in the past, will stubbornly enforce its own dissolution, unless, in the instinct of self-preservation, it obeys at last the imperious dictates of science.

Among Firms who have earned honourable reputations as specialists in their several departments of engineering, Messrs. T. & T. Vicars, of Liverpool and Earlestown, Lancashire, take high rank. When the two cousins, Thomas Vicars the elder, and Thomas Vicars the younger, founded their Firm, nearly forty years ago, baking machinery was in a very primitive state, and a great deal of the work was still done by hand. It would be untrue to say that hand-making is to-day altogether obsolete; but, while for certain sorts of biscuits it continues to be practised by small concerns, in the great biscuit factories machinery is almost invariably substituted. Messrs. Vicars, early in their career, had their attention drawn to the system of machinery for bread and biscuit baking, and in 1852 they took out their first patent for a better form of bread-baking oven; since which time they have constantly introduced new machinery and ovens, their aim being to obviate, as much as possible, the necessity of touching the dough by hand, and also to secure a greater uniformity in the articles manufactured. Content at first in endeavouring to improve the few machines then in existence, they soon found them, however, inefficient for the growing trade in biscuits, and inconvenient in working, as such machines required to be assisted by a considerable exercise of manual labour. This caused Messrs. Vicars to discard many of the old ideas, and to bring their talents to bear upon the invention of new appliances. In the result they were led from the mixing-machine to the brake, or rolling-machine, thence to the cutting or stamping-out machine, and, finally, to the oven. The present method of manufacturing ship as well as fancy biscuits is, undoubtedly, the outcome of their labours, and to them may be given the credit for its introduction not only to the leading British biscuit manufacturers, but to the principal foreign and colonial houses, as well as to the Government bakeries in Malta, Aden, and the East Indies.

It should be interesting to name the most notable of their inventions, and to give a brief description of the leading points of each. Their vertical mixing-machine is suitable either for biscuits or loaf bread making. It is used principally for mixing rich, soft doughs, and consists mainly of two vertical shafts, upon which are fixed screw-formed knives or arms; these, with the necessary gearing, are carried on a strong iron framework. The flour and other ingredients are put into an oval-shaped wooden trough, which, being fixed upon a carriage with wheels,

THOMAS VICARS, THE ELDER.

an encroachment upon the working space. When working soft doughs, the machine has attached to it a web, the exact action of which need not be described. Messrs. Vicars are the patentees of another ingenious machine for the manipulation of both hard and soft doughs. It performs quite a combination of services, the nature of which will be broadly understood even by the uninitiated. It "gauges" or controls the thickness of the dough, cuts it into the required shape, and deposits the biscuits upon the baking-pans or wires ready for the oven, besides separating the "scrap" which results from the shaping of the design. The illustration on page 130 will convey some idea of the arrangement of this machine, which is of extra strength and power, to meet the general purposes of the biscuit trade, for by it every description of dough can be cut and manufactured. It is supplied with specially-prepared woollen webs, made to suit rich, soft doughs, and two extra rollers, the top one of which is of brass, and grooved so as to crimp the upper surface of the biscuit, if required. When not in use, the crimping-roller may be lifted clear of the dough. In this, their newest form of cutting-machine, Messrs. Vicars have introduced several important improvements, the chief of which has for its object the production of an even sheet of dough for thin and high-class biscuits. By the introduction of a train of wheels it is only necessary to change one wheel to obtain a variation in the delivery of the dough. Another improvement is in the direction of

increasing the sharpness and permanency of the impression of the design upon the dough; and the machine is also an economiser, as has been hinted. The die-plates, which cut out the shapes of the biscuits from the dough, lie close together, so as to yield but a small quantity of "scrap"; and one of the webs of the machine carries back the scrap to be worked up again into the mass of dough.

Their patent plate-oven for ship and dog biscuits, and their chain-oven for fancy biscuits, also deserve some remark. These ovens are generally called "travelling" ovens, which term may be somewhat misleading and likely to convey the idea of a portable oven. The name, however, is derived from the fact that the "sole," or principal gear of the oven, consists either of an endless chain of plates—as in the ship and dog biscuit oven—upon which the biscuits are placed, or—as in the case of the chain-oven—of a series of endless chains, upon which the pans of biscuits, when taken from the cutting-machine, are placed. The first class of oven is used for baking ship or dog biscuits and the like, and the second for all kinds of fancy biscuits. The

THOMAS VICARS, THE YOUNGER.

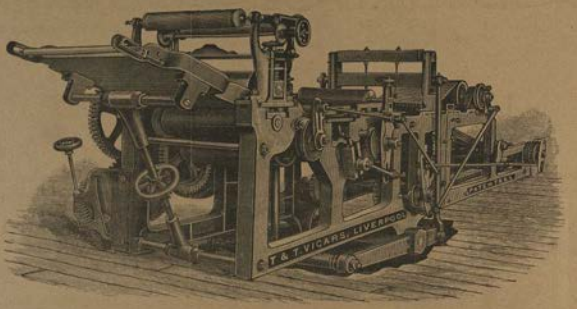
process of baking is continuous; and the biscuits, having been passed into the oven at one end, are properly baked by the time they arrive at the other. The period of baking is easily regulated to suit the quality of biscuit, some requiring a much longer time than others. The heat of the oven is also completely under control by means of dampers placed at suitable points in the flues.

Since the decease of the two founders of the Firm, the business has been carried on by Mr. John Vicars, nephew of the elder Thomas Vicars, and Messrs. Thomas and John Vicars, sons of Thomas Vicars the younger, and they are ably following in the footsteps of their predecessors, by introducing improvements in the machinery and ovens wherever it is thought possible or requisite in order to keep pace with the increasing demands of the trade. It will be understood that the inventions and improvements of this Firm have much assisted in bringing the biscuit trade to its almost scientific state of perfection from the rule-of-thumb condition it once knew.

Besides the machinery and ovens already enumerated, Messrs. T. & T. Vicars have introduced many smaller machines and appliances required in biscuit and bread-making, including boomerang ovens, sugar-wafer stoves, mechanical stokers for boilers and char-kilns, rout-presses, spraying-machines, and flour-sifters. A not

unimportant part of their business is the fitting-up and engraving of the various dies for forming and impressing biscuits; and when it is considered that the forms and designs made in England are so many and that each foreign country calls for some peculiarity to suit its customers, it will be seen that considerable skill and ingenuity have to be exercised to meet the various tastes.

Messrs. Vicars' connexion is world-wide. Most of the eminent biscuit-baking firms in Great Britain have adopted their patents in some form or other; and the same may be said, in a modified degree, as regards continental manufacturers. The Firm have fulfilled orters in France, Germany, Russia, Turkey, Austria, Spain, Portugal, Italy, Denmark, and in Holland. In the United States their machines are well appreciated, and they



VICARS' NEW PATENT CUTTING MACHINE.

have been laid down in remoter parts of the globe—South America, India, China, Australia, New Zealand, Canada, and the Cape. Although the high reputation of the Firm has been acquired chiefly by the manufacture of biscuit machinery—which has obtained high awards wherever exhibited—Messrs. Vicars are not unfavourably known as makers of ovens and other appliances specially for the loaf-bread trade. In addition to their work in these two branches, they have, for the last twenty years, given concern to the question of economy of fuel, and the prevention of smoke, and have succeeded in producing a self-stoking mechanical furnace, which received the highest awards at Smoke Abatement Exhibitions at South Kensington and Manchester, and has met with favour wherever it has been adopted.

Messrs. Hammond & Co., London.

THE splendid new premises opened by this Firm in 1886 mark the progress made in the art of high-class tailoring during the last half century. Many persons can remember the dingy places where the nobility of this country attended to be measured for their outfits—shops where there was hardly room enough to swing the proverbial cat—stuffy, ill-ventilated houses, which contrasted widely with the stately homes of the noble customers who frequented them. If we could visit the first building rented by the founder of the Firm of Hammond & Co., and compare it with the present fine edifice, we should be in a better position than we are to appreciate the luxuries enjoyed by this Firm and its patrons at the present day.

He would be a non-observant man who could pass down Oxford Street to Regent Circus without pausing to admire the exterior of one of the finest modern buildings on the Duke of Westminster's estate. The stranger would be puzzled to know what kind of business was transacted within. Many large banks are not more imposing in appearance; and since Messrs. Hammond do not expose goods in their windows, it would be a pardonable error if the inquirer surmised that it was used for receiving deposits of silver and gold. That a good share of the noble metals finds its way into Messrs. Hammond's coffers there can be no reason to doubt, but the depositors who cross their threshold require an equivalent that only a few firms in the great metropolis can offer. This may seem a bold statement, but when the reader considers the great amount of skill and care required in order to clothe the aristocracy of Great Britain, he will doubtless endorse our remarks. Where is the individual who can look well in an ill-fitting suit of clothes? And conversely, every one knows that a good tailor can effect a metamorphosis upon the most awkward-looking man in creation, and turn him out so that his own friends will hardly recognise him. Apollo, *au naturel*, is the delight of all artists, but Apollo in badly-cut clothing would pass on unnoticed by the keenest art-critic. One can hardly discuss the subject of clothes without thinking of Carlyle; no philosopher understood better than the Chelsea Sage the value of clothing to civilised man. Other observers of human nature have also noted the effect of clothing upon the human race, and Shakespeare put into the mouth of Polonius the well-known lines,—

> Costly thy habit as thy purse can buy,
> But not expressed in fancy; rich, not gaudy,
> For the apparel oft proclaims the man.

Which signifies that it is easy to judge a man's character by the clothes he wears. This is as true of to-day as it was of the Elizabethan period. Although male attire, even of the loudest description, is sombre to what it was in the time of Queen Bess, the gentleman of to-day is readily distinguished from the *parvenu* by the cut and colour of his clothes.

The Firm under notice has been established over a century. Its founder began business in a small

way, but by dint of hard work and straightforward trading he managed to attract the attention of the notabilities of his time. His specialty was breeches, and although Messrs. Hammond supply every article of clothing the English gentleman can possibly require, they are still recognised as the first breeches makers in the land. Only the man who rides can thoroughly appreciate perfect-fitting breeches. The sportsman naturally feels a sort of affection for his breeches maker, and when once he finds a tailor who is able to give him a perfect and easy fit, he never feels inclined to change. The late Charles Reade, the eminent dramatist and novelist, some years ago found a shoemaker who so thoroughly understood the anatomy of the human foot that he ordered a large quantity of boots from him. "This man might die before me," said Mr. Reade, "and then, in all probability, I should not get another pair of boots to fit me so perfectly." At the great novelist's death, enough new boots to last an ordinary wearer about fifteen years were found in his bedroom!

Upon entering Messrs. Hammond's new premises, the visitor finds himself in a lofty and well-furnished

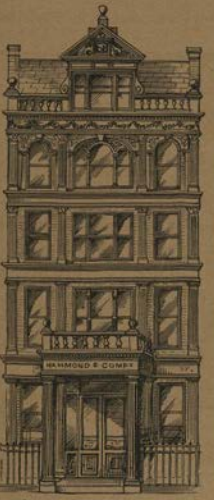
THE LOUNGE.

lounge. Upon the table are to be found books and papers congenial to the tastes of country gentlemen and sportsmen. On a shelf is fixed one of the Exchange Telegraph Company's automatic type-printing instruments, which records the prices of stocks and shares and the leading events of the hour. This lounge reminds one of a room in a well-appointed club. It is certainly a novel idea, and it is, doubtless, well patronised by Messrs. Hammond's customers. The lounge, as well as the other parts of the building, is lighted by electricity. The electrical energy is obtained from one of the Elwell Parker dynamos, driven by an Otto gas-engine of 8-horse power. In order to secure perfect steadiness in the light, the lamps are worked from secondary batteries, and not from the dynamo direct. All the patterns belonging to this Firm are carefully preserved in a fire-proof room. Here we noticed the paper shapes of the breeches, knickerbockers, &c., worn by H.R.H. the Prince of Wales, other members of the Royal Family, and some hundreds of the British aristocracy, as well as certain foreign potentates, who patronise Messrs. Hammond.

These patterns are never destroyed; the names of the customers are printed legibly upon each, and can be produced at a moment's notice. This must be a very convenient arrangement for gentlemen

who have to travel, or whose political, military, or naval duties compel them to absent themselves from England for long periods. By simply writing to Messrs. Hammond & Co., they can ensure the most perfect fit without paying the Firm a visit. The dressing-rooms are well furnished and include toilet requisites, modern bootjacks and mounted saddles. The latter are to enable the sportsman to feel as if he were really mounted, and to discover at once any fault that might require remedying.

It is a well-known fact that contagion has frequently been carried in new clothing from the home of the artisan to the residence of the customer. Zymotic diseases, such as typhoid, typhus, and scarlet-fevers have been conveyed to families in this way; therefore, to guard against such calamities, Messrs. Hammond have



465, NEW OXFORD STREET, W.

everything made in their own workshops, which are thoroughly lighted and ventilated, and the cleanest and best in every respect that we have seen. The workmen are not even allowed to take their coats and hats into the rooms where the clothes are made.

We did not see a single sewing-machine upon the premises, which proves that every stitch is done by hand, thus ensuring the greatest amount of durability so far as the work is concerned. The sanitary arrangements are perfect, and nothing is wanting to make the establishment worthy of the extensive patronage it receives.

In passing, we may mention that Messrs. Hammond are ladies' tailors as well as gentlemen's outfitters. Their name is a sufficient guarantee that the quality of the materials they use is of the best that our manufacturers can produce.

Messrs. D. Clark & Sons, Walsall.

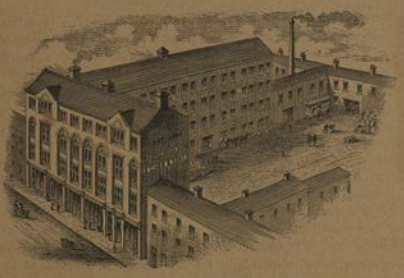
IF "Cleanliness is next to Godliness," then Brushes and those who make them are important contributors to the health, comfort, and happiness of the general community. The purposes for which Brushes are now used are almost boundless in their extent and variety. We require them for the completion of our toilet, for the cleanliness and decoration of our homes, and for the sanitation of our cities; while the artist, the miner, the shoemaker, the miller, the weaver, and those engaged in nearly every trade and profession, find Brushes an important auxiliary in assisting them in their various arts and industries. This has not always been so, for it is little over a century since combs only were used for dressing the hair, while the luxury of even a shaving Brush was unknown. Nearly every new phase of our civilisation thus makes fresh demands upon the Brushmaker's art; so much so, that the Bristles of the wild boar from which Brushes are made, are yearly becoming scarcer, and deteriorating in quality through contact with that very civilisation to whose needs and comforts he so much administers. It is, therefore, one of the problems of the near future to find out what can take the place of the rapidly decreasing supply of Bristles, and to adapt efficient substitutes in the manufacture of Brushes.

Among the towns that are famous for the manufacture of Brushes, especially saddlery Brushes, Walsall, in Staffordshire, has for a long time been pre-eminent. Mr. David Clark, the founder of the Firm of D. Clark & Sons, was born in the town in the year 1824 of parents in very humble circumstances, whose necessities compelled them to put him to work when about nine years old. About fifty years ago he was placed indoor apprentice to the Brush-trade, to one of the oldest Brush Firms in the town. This was before the era of Factory Act legislation, and the rigours of the apprenticeship system then in vogue are but little understood by the present generation. Suffice it to say that, although he had often to toil from 14 to 16 hours per day, he yet found time to improve his education, and to make himself useful in the sphere in which he moved. When he was twenty-one, he decided to leave his master, and with a shilling in his pocket he set out to face the world. After varied experiences and many vicissitudes, he commenced business in his native town in the year 1849, with little capital, and with no friends of any influence to assist him. For many years it was a severe struggle with adversity, but in the year 1866 he had so far established a thriving business that he built himself a large Factory and Warehouse near the railway station of the town. Here his trade considerably increased, and from being a maker of Household Brushes only, he commenced the manufacture of Brushware in its entirety, including the three other distinct businesses, viz., Saddlery, Paint, and Toilet Brushes. Here also was laid the foundation of his colonial and foreign business, which added so greatly to his growing reputation. In the year 1875 he found his premises again too small for his requirements, and in 1876 erected his present extensive Works, the illustration of which is given on the next page. At the same time he took into partnership his two sons, who had been taught every detail of the business, and

who are now associated with him in its management. About this time the Firm also commenced contracting for the supply of Brushes required in the various departments of Her Majesty's service, which they still continue to do. During the Afghan and Egyptian campaigns they sometimes made as many as 10,000 brushes per week for the use of the troops, and yet were able to attend to their ordinary extensive business in addition. They have also held important contracts for foreign Governments, supplied largely the requirements of the principal Railway and Shipping Companies, as also some of the leading municipal and sanitary authorities of the United Kingdom. They have thus managed by energy and resource to win a foremost place among the Brush manufacturers of Great Britain and of the world.

A visit to their Works reveals the secret of this success. Here they have *every possible method of economising labour, and preventing waste of material.* Every detail of their business is personally superintended by each of the members of the Firm; while the stores of bristle, wood, &c., used in the manufacture of Brushes are almost boundless in their extent and variety. When we add to this, that punctuality and despatch have always been the leading characteristics of the Firm; that every department seems perfectly organised; and that they have gathered round them a staff of devoted, industrious, and sober workpeople, it will be seen that they have done everything to deserve success as well as to attain it.

Space forbids us to describe in detail all their varied manufactures, or the many processes each brush has to undergo before it is completed. In their large and handsome show-room, there are over 2,000 different patterns of Brushes, including specimens of *every conceivable kind of Brush*, ranging from the large unwieldy gun brush for cleaning cannon, to the tiniest of camel-hair brushes for artist's use. The *novelty* of many of the Firm's manufactures is also a striking characteristic. We were shown a Broom into which the stail was easily and effectively screwed, instead of being nailed; Shoe Brushes put up in beautifully decorated tin boxes, with blacking, tin, and everything complete; Groom's Packets, containing every Brush needed in a stable, put up in a handy form; together with many others of real excellence and utility.



VIEW OF PROVIDENCE BRUSH WORKS.

No one could walk through the Works, without noticing how much attention has been paid to the health, cleanliness, and comfort of the workpeople; the loftiness and thorough ventilation of all the rooms; the intelligence and cheerfulness of all as they were busily engaged at their work, and the order and discipline that was everywhere observable.

The machinery introduced by the Firm calls for more than passing notice. Since 1879 they have paid special attention to its application for the manufacture of Brushes, *and are yearly adding considerably to their plant.* A machine, which is attended to by a youth, does the work of ten men, and drills from 80,000 to 100,000 holes per day; and other machines do a proportionate amount of work in boring, finishing, and shaping the Brushes.

The numerous warehouses are exceedingly interesting. There we saw Bristles of all colours and qualities from Germany, Russia, Siberia, China, India, and America; fibres from Mexico, Ceylon, and South Africa; weeds from Italy and South America; beautifully dressed horsehair and whalebone, and all kinds of wood from the beech, sycamore, and alder of home growth, to the more richly-grained mahogany, teak, satin, and rosewoods of foreign countries. While thus receiving raw material *from nearly every part of the world*, we noted that the *Firm's manufactured goods were almost as widely distributed*, to judge by the cases we saw being despatched to all parts at *home and abroad.* When to this we add that the new price list recently issued by the Firm enumerates nearly 5,000 kinds of Brushware, enough will have been said to justify a prominent position being given to them, as amongst those, who have through perseverance and industry, won for themselves a reputation during the Victorian era.

Mr. William Johnson, Castleton Foundry, Leeds.

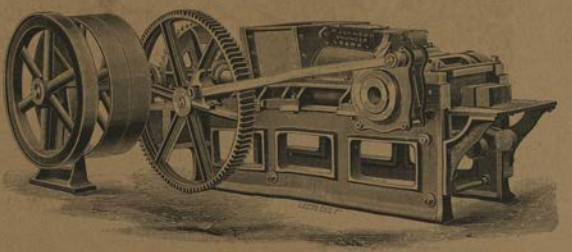
THE subject of the manufacture of bricks has not received that attention from men of inventive faculty and genius as many other articles which have not, perhaps, an equal claim to notice from their importance as these have. Mr. Johnson, of Castleton Foundry, Leeds, who is also a large brick manufacturer, has spent many years in the special study of this subject, and has succeeded with important inventions by which the difficulties hitherto present in brick-making by machinery have been practically overcome; this machinery is adapted to all kinds of clay, and from its simplicity only the most ordinary skilled labour or supervision is required, and the best results are obtained at the least cost and trouble.

The business of the Castleton Foundry was commenced for the special manufacture of brick-making, pressing, sanitary pipe making, and general clay working machinery, and is now being kept successfully employed. The value of Mr. Johnson's inventions is becoming recognised, and as the advantages they possess are more understood their worth will be still more appreciated. Perhaps no novelties in machinery have had given to them such favourable notice and unqualified commendation by the leading technical journals as these have obtained. Mr. Johnson in his engineering business has laid himself out for dealing with all kinds of clays, and also for providing machinery for the various kinds of goods manufactured therefrom, viz., sanitary pipes, glazed bricks, as well as fire and general building bricks, and tiles.

Mr. Johnson has taken up several specialties in connexion with the manufacture of this class of goods, viz., the utilisation of the slate waste or débris in the making; also the production of sand-faced bricks, which command a very high price, having previously been made by hand only. Mr. Johnson has also made the subject of kilns a special study, and may be entrusted with confidence for supplying plans and laying out plants on the most approved and economic principle.

We add a few illustrations of examples of Mr. Johnson's machinery: the first is what he calls his Plastic Brick-making Machine B (No. 1). This machine works in conjunction with his Patent Lever Steam Brick and Tile-pressing Machine (No. 2). These two machines stand in close proximity to each other, to allow of the brick as it is delivered by the brick-making machine to be passed by a small boy at the rate of 10,000 per day in front of an arm of the press which feeds it into the mould, the brick being fed and delivered automatically. The clay may be prepared either by perforated grinding-mill, solid pan, or horizontal rollers. The principle of the working of the machine is as follows: The clay after being prepared is fed into the hopper which is at the head of a cylinder, partly closed and partly open; immediately on the clay being fed into the machine it becomes subjected to a churning and a kneading action, by which the air is thoroughly expelled, and is made into a dense and stiff plastic body before being fed into the moulds, which are formed in a revolving cylinder that has an alternate action to allow of the mould being filled and the previously-formed brick being delivered. The action of forming the brick expels the one already made, and the surplus clay left after the filling of

the mould is automatically discharged back again into the machine. The motions of the apparatus are not only simple but direct in their action, and it is practically impossible for the machine to get out of order, or to fail in performing its functions, providing it be kept supplied with clay. The bricks produced are the very best quality of plastic make, and when delivered from the pressing machine are finished in the best possible form. The bricks are produced at the rate of 10,000 per day and are taken direct to kiln without any intermediate drying, at the same cost as by the semi-dry process. The machine only requires the attendance of three boys.



No. 1.

The above process demands something more than a mere cursory notice, inasmuch as it accomplishes a revolution in brick-making which is most important. There have been for some years in operation what may be called three processes of brick-making, viz., the plastic, semi-plastic, and the dry process. The first of these is the only one that can be adopted with clay that is naturally extremely wet, but on account of the necessity for the bricks being dried previously to going to kiln, and the expensive plant and large space required, it is a much more costly method than the two latter. The process which has been called the semi-plastic has attempted to go between the two in the matter of plant and cost of producing; but excepting in very few cases where the clay has been specially favourable, it has scarcely been a remove from the dry process, and therefore has had the same disadvantages attending it which have characterised that process.

The Dry Process. For bricks to be made by this process the clay must be reduced to a fine powder, and being then slightly damped is fed into a mould in a granulated state, and formed into a brick by a heavy pressure being brought to bear upon it. The bricks which are made by this process (excepting in very special instances where the material is naturally a very dense and close body, and adhesive) are porous and absorbent, and soon begin to disintegrate and crumble away with exposure, and are totally unfit for engineering and outside work.

The semi-plastic bricks produced by Mr. Johnson's process are entirely distinct from any of the above, and have that special feature of possessing all the advantages of the best plastic make, with even greater simplicity of plant and at no higher cost in labour than that of the dry process. Another feature is that it is found that a high-class engineering brick can be produced from material that is weak and deficient in body, and containing as much as 25 per cent. of lime. Bricks cannot be made from such material as this by any other process than by washing, and even with this latter expensive process it is impossible to produce other than a weak and low quality of brick. From the simplicity of the plant required for Mr. Johnson's process, it is well adapted for contractors' temporary work as well as for permanent. The best quality of facing-bricks, fire-bricks, &c., are produced by this process, and at a merely nominal cost in labour and in wear and tear. Any kind of clay that is not naturally extremely wet, as well as marl, shale, &c., is suitable to be worked in this way.

Illustration No. 2 is a Patent Lever Steam Brick and Tile-pressing Machine. This is used for pressing bricks and tiles made by either machine or hand, also for pressing paving tiles up to 12 in. square. The arrangement and action of the machine is so simple and direct that bricks and tiles are finished even more neatly direct from the cutting-off table of pug-mill machine than is possible by hand work, even when the bricks have been previously dried, thus insuring not only a slight cost in labour in performing the work, but also reducing the expenditure on drying-floors, and entirely saving the cost of putting the bricks down on the floors, and of gathering them up again before being pressed, which is the usual practice.

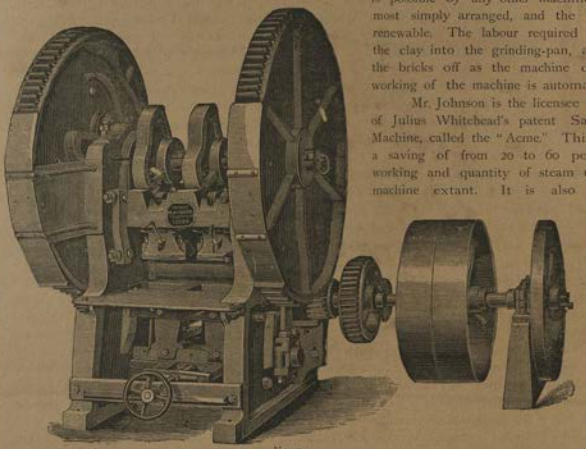
Illustration No. 3 is a Patent Semi-dry Brick-making Machine. The design and arrangement of this

machine is such that the clay, which is reduced to a granulated state, as previously described, can be fed in a much damper state than by any other machine of its kind. Its mode of working is as follows:—

The clay or material to be formed into bricks is fed in a loose and granulated state into a hopper, at the base of which, working in a slide on the face of the table, is a bottomless box or charger, which receives the clay or other material from the hopper, and sliding over the face of the moulds formed in table, fills them. To insure a certain and dense feed, the pressing-head drops with its own weight (3 cwt.) upon the material while the charger is still over the moulds; the pressing-head is then raised to allow the charger to return again under the hopper to be refilled, and, in its passage, it strikes off the loose material level with the face of the moulds. The pressing-head drops a second time upon the material in the moulds, and, during the time it remains there, two additional distinct and powerful pressures are given, thus making the brick or article pressed dense and in perfect form. The presser then leaves the moulds and the bricks are raised for delivery, which is performed by the charger returning again to refill the empty moulds, and delivers the finished bricks, at the same time, ready for the attendant boy to remove on to a wagon or barrow to be taken direct to kiln. Each brick receives four distinct pressures, thereby thoroughly discharging the air (no other machine made of this class gives more than two pressures). The peculiar mode of charging the moulds insures a regular and even feed of clay for making each brick, thereby enabling any kind of granulated clay to be fed in, and also in a much damper state than is possible by any other machine. The machine is most simply arranged, and the wearing parts easily renewable. The labour required is, one man to tip the clay into the grinding-pan, and one boy to take the bricks off as the machine delivers them. The working of the machine is automatic and constant.

No. 2.

Mr. Johnson is the licensee for the manufacture of Julius Whitehead's patent Sanitary Pipe-making Machine, called the "Acme." This machine will effect a saving of from 20 to 60 per cent. on cost of working and quantity of steam used over any other machine extant. It is also well adapted for making all kinds of special goods, such as oval pipes, invert blocks, retorts, fire-clay linings, &c. He has also recently invented a machine for moulding and printing soap tablets; and another machine for moulding and pressing cattle or seed cake, which cannot fail to supersede the slow and expensive mode of producing these by hydraulic machines. The work is done without any labour, excepting for the removal of the cakes as they are discharged by the machine.



No. 3.

Space will not admit of more than a mere reference to the manufactures of the Castleton Foundry, but from what has already been said Mr. Johnson is to be congratulated upon the success he has achieved in his own line, which has received the attention of the trade and of exporters of foreign and colonial requirements.

Price's Patent Candle Company, Limited, London.

PRICE'S PATENT CANDLE COMPANY, LIMITED, has so long occupied a prominent place amongst the great candle-making establishments of the world that its name is familiar in all parts of the globe. It was one of the first firms to apply in commercial enterprise the discoveries of the veteran French chemist, Chevreul, the hundredth anniversary of whose birth was recently celebrated in Paris; and now that stearine has been so largely replaced by paraffin, it occupies the position of being the largest refiner in the world of this beautiful material. Before Chevreul's researches made known the constitution of fats, candle-making was one of the simplest of the arts, and candles were crude productions indeed. But his discoveries led to candle-making becoming an elaborate chemical art, and have enabled candles to hold their ground against such formidable opponents as gas, petroleum, and the electric light.

Leaving out such expensive substances as bees' wax and spermaceti, the material from which candles were manufactured up to 1831 was tallow. Chevreul had shown in 1823 that this substance, when decomposed, yielded a hard, fatty acid available for candle-making, viz., stearic acid; oleic acid, useful for soap-making; and glycerine, a substance of great value in medicine and the arts. He and Gay-Lussac attempted in 1825, but without success, to prepare the fatty acids on a manufacturing scale, but De Milly and Motard succeeded in 1833 in producing from good and expensive tallow, stearic acid candles, the famous "Bougies de l'Étoile," which were sold in Paris at 1s. 8½d. per lb.

While to France belongs the honour of introducing the new industry, to England must be given the credit of placing it on a substantial manufacturing basis. Not until Messrs. George F. Wilson and W. C. Jones's discoveries of the method of distilling the fatty acids with the aid of super-heated steam, and of preparing white and inodorous candle-making materials from palm oil and other inexpensive, dark-coloured fats by means of acidification with sulphuric acid, did the industry take root and begin to expand. Messrs. Wilson and Jones's discoveries were patented on behalf of E. Price & Company (afterwards Price's Patent Candle Company, Limited), and formed the foundation on which was built up a business which rapidly grew in importance, and which still holds the prominent position gained some forty years ago.

Fatty acid candles,—"stearine" candles, as they are called in the trade,—are manufactured in England, and in great quantity on the Continent, chiefly in France, Belgium, Austria, and the Netherlands. The raw materials employed are chiefly palm oil and tallow.

The inventions just referred to have not only had a most important effect on the fatty acid industry, but have had a no less vital bearing on the West African Slave Trade. A writer on commercial industry says, in 1854:—"The trade in palm oil has almost driven out the slave trade from the Bight of Benin, which was, a few years ago, one of its principal seats." Captain Forbes, R.N., writes thus in 1850:—"The inhabitants of a vast

extent of coast have been led to give up the slave trade because they have been taught the immense increase of the value of the palm oil trade over that in slaves."

The finest stearine candles manufactured by Price's Company are called "Belmont Sperm," or "Best Stearine," and are well known in all export markets for their uniformly high quality.

In the English market, "Price's Best Composites" have for long held a similar position to that secured by the "Belmont Sperms" in the export trade, and they resemble the latter closely in appearance and quality. From the day when, in 1840, Mr. J. P. Wilson introduced for use in the illuminations in honour of the marriage of Queen Victoria the first cheap self-snuffing candle, until now, "Price's Composite" has been a household name. Cheaper raw materials than the vegetable and animal fats have, for the time being, interfered with the sale of composites; but they are not likely to lose their place as useful household candles.

In 1851 a new candle-making material,—paraffin,—made its appearance, and Price's Company were not slow to utilise the novelty. While the late Dr. Young's patent was in force the production of paraffin was small, but after its expiry the manufacture was greatly increased, and now paraffin has become a most important candle-making material. But paraffin, while beautiful in appearance and of great intrinsic value as an illuminant, has a weakness, for candles made of it alone cannot be used in heated rooms without bending. To remedy this

defect a fatty acid must be mixed with it, and much attention has been devoted by Price's Company to the manufacture of a high-class candle, combining in the highest degree the valuable characteristics of paraffin and palmitic acid. The success of the universally known "Gold Medal Palmitine" candles shows how well the problem has been worked out.

But Price's Company have not forgotten that there is a class who give the preference to mere beauty of appearance; and, in their "Best Paraffin" and "Belmontine" candles, they exhibit the exquisite transparency, freedom from colour, and excellence of finish that can be attained in the case of hard or high melting-point candles made of this substance.

The candles we have named are bought by the "Upper Ten," but paraffin candles appeal also to the million. In Price's "Cowslip Wax" we have a candle which, for economy, is within reach of the most modest purse, and, on the score of appearance, is no disgrace to the parlour.

Mixed paraffin and stearine candles, known as "Sperms,"—viz., Price's "Sherwood Sperm," Price's "Imperial Sperm," Price's "London Sperm,"—are manufactured for bedroom and carriage-lamp purposes, and for export to countries where less than tropical temperatures prevail.

Next in importance to the candles made by Price's Company come their well-known night-lights, which have cheered so many sick-rooms during the weary watches of the night, and brightened so many

nurseries where youthful imaginations were wont to call up every form of spectre. These household requisites are so widely known as to need little description. They are of two kinds, Price's "New Patent," which are moulded like candles and burned in neat little glass cups provided without extra charge, and "Childs'," which are contained in paper cases ready for burning when placed in a saucer containing a little water. Sometimes these night-lights are used for lighting purposes alone, sometimes for heating food as well.

Perhaps there is no article with which the name of this Company is more commonly associated in the public mind than glycerine. Nearly thirty years ago pure glycerine was manufactured for the first time under Mr. G. F. Wilson's patent, and this gentleman's discovery of the method of purification has given to medicine and the arts a material the value of which is yearly becoming better appreciated, and its use is in consequence spreading in many directions. In the matter of absolute purity, Price's Company led the way, and they have succeeded in keeping the foremost position amongst a crowd of competitors.

Another important product is the liquid fatty acid obtained from palm oil, &c., along with palmitic acid,—viz., oleic acid, or *Olaine*, as it is generally called in the trade. This fatty acid was introduced into the Yorkshire mills by Price's Company in 1851 under the name of cloth oil, and since then has been used for scouring purposes in large quantities.

Price's Company also manufacture many varieties of toilet soaps, specially Price's "Solidified Glycerine Soap," containing half its weight of glycerine (an excellent preventive of chapped hands); and Price's "Glycerine and Carbolic Soap," combining the emollient properties of glycerine with the disinfecting qualities of carbolic acid.

Price's Company are also manufacturers of all kinds of lubricating oils. Their "Belmont Spindle Oil" is well and favourably known in Lancashire and Yorkshire; their "Sherwood Sperm Oil" is extensively used for general machinery lubrication; and their "Special Gas Engine Oil" is employed wherever gas engines have found their way.

Price's Candle Company's Works are situated at Battersea on the Thames, and Bromborough Pool on the Mersey, and the Company find employment for about 1,500 hands. At both establishments much attention is given to the physical, educational, and moral well-being of the employés.

Messrs. Morton & Sons, Kidderminster.

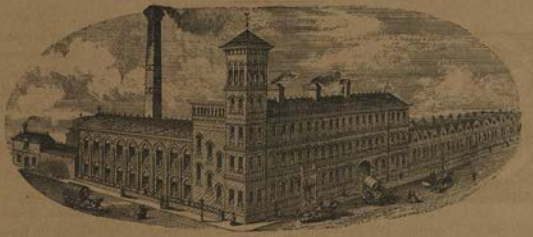
KIDDERMINSTER, known in early times as Caeder-Minster, is pre-eminently the centre of the Carpet Industry of the world. Here the richest, most expensive, and most artistic carpets are manufactured: Tournai or Wilton, Moquette, Brussels in the numerous qualities, Tapestries, Royal, Indian, and Patent Axminsters, and a great variety of beautiful Rugs. The trade is one of great antiquity. It is first mentioned in the days of Amos, 800 B.C., and for centuries the most splendid specimens of Oriental work were woven in India, Persia, and Turkey. The industry was first introduced into France in 1590 by Henry IV., and was developed in the Flemish towns of Bruges, Ghent, and Brussels. In the year 1709 the art of weaving carpets was brought over from Brussels to England by the Earl of Pembroke, and became established at Wilton. At first this Brussels fabric was woven in silk, with a round or terry wire, as used in Flanders; but the difficulty of procuring silk in England led to the employment of worsted. The result of this change in the material was not at first satisfactory, and in consequence the Tournai, or cut-wire, was substituted for the round wire, and the name of Wilton was adopted for the English market in lieu of that of Tournai, the Flemish town where it was originally made.

Exactly forty years afterwards the industry was commenced in Kidderminster, where weaving of various fabrics had been extensively carried on for many generations. The manufacture of bombazine having been the staple trade, on the introduction of the carpet loom the two industries were carried on in combination, until the older trade died out, when the manufacture of carpets became and has remained the paramount one. In the latter part of the last century the business of which Messrs. Morton & Sons' is a continuation was founded. It is now the oldest and one of the most eminent houses in the carpet trade, and has received a world-wide reputation for excellence of material, rich combination of colouring, and superiority of design. The founders were John Woodward, an extensive woolstapler of Evesham, and James Morton (who was formerly associated with the eminent banking firm of Robarts & Co., of London), the grandfather of the present esteemed member of the Firm. The combined bombazine and carpet trades were carried on for many years most successfully by this Firm, and upon the retirement of Mr. Woodward, Mr. Morton took into partnership his two sons, William and Edward, under the style of Morton & Sons.

Until the middle of the present century carpets were woven by the slow and steady process of the hand-loom; but at the great International Exhibition of 1851 a sample of carpet woven by steam power was shown by Erastus Bigelow, of America, and the change from hand to steam power very soon completely revolutionised the carpet trade. The monopoly of the patent rights for Great Britain having been acquired by a Yorkshire Firm, there were indications that the carpet trade would pass away from Kidderminster. It has been remarked, on more than one occasion, that intense personality or individualism in surmounting difficulties has ever been a characteristic of those engaged in sustaining and developing the higher branches

of the carpet industry, and these features were exhibited in a marked degree by the Firm of Morton & Sons, they having grappled with the altered circumstances, and laid down new machinery, embracing all the latest improvements, whereby they were enabled to extend their business operations, and maintain their reputation for excellence of quality and design.

Mr. William Morton having died in 1859, and Mr. Morton, senior, in 1860, the business was continued by Mr. Edward Morton, who a few years afterwards took into partnership Mr. T. Tempest-Radford, who had just retired from the Firm of Woodward & Radford. It was immediately after the partnership of these two gentlemen that the present mills, as shown in the engraving, were erected; and they undoubtedly form one of the most extensive, complete, and best equipped mills in Kidderminster, while their architectural and constructive features arrest the attention of the passer-by. With the determination to ascertain for himself what were the real requirements and tastes of the markets of the world, Mr. Tempest-Radford has, from time to time, visited the principal countries of Europe, the United States, Canada, the Australian and New Zealand colonies, and, so recently as 1884, the Argentine Republic; everywhere opening and permanently establishing commercial relations with all the leading houses, and by the intimate knowledge he has thus acquired of the characteristics and requirements of the different countries, the Firm have been enabled in an especial manner to cultivate and meet the varying tastes of the numerous nationalities. On the death of Mr. Edward Morton, Mr. Tempest-Radford was joined by Mr. Edward J. Morton, grandson of one of the founders.



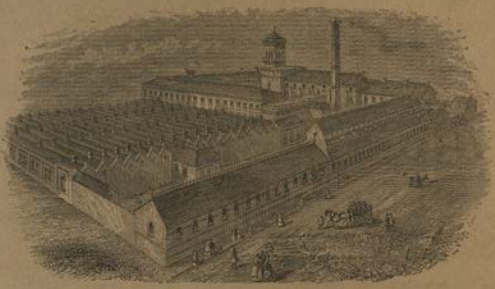
FRONT VIEW OF MESSRS. MORTON AND SONS' MILLS, KIDDERMINSTER.

The products of the Firm now include many descriptions of Wilton, or Velvet, Brussels, and Royal Axminster carpets, and a variety of high-class rugs. On the introduction of the Royal Axminster fabric, this Firm made a large addition to their mills, laying down for this branch an entirely new and costly plant, to meet the demand for this beautiful carpet, which, from its richness, softness, and durability, combined with a very moderate price, gave a great impetus to the use of cut pile carpets, both in England and abroad. They have also been associated with other special features in the trade, and a few years ago they brought out "The Moresque Carpet," which attracted universal attention, and had an enormous sale, as by its application a blending of colours was obtained and a richness of effect produced unattainable in any other way, and the want of which had long been felt by the trade. They do not profess to compete with houses whose chief aim seems to be to manufacture carpets to sell at a certain price, but their motto has always been excellence in every branch of the industry. From the first, this Firm have retained the services of artists of the most unquestionable ability, and the whole of their varied designs have been produced by their own artists. The chief of this important department is Mr. Grose, who has been with the Firm for upwards of a quarter of a century, and who has now, together with Mr. Heat and Mr. Webster, two of the principal representatives of the Firm, a direct interest in the business. Indeed, it is one of the characteristics of Morton & Sons that the principal members of the staff, as well as the chiefs of nearly every other department, have grown up in the service of the Firm.

In such a limited space as the present article, it is, of course, impossible to describe the many interesting and ingenious processes of carpet weaving by the Jacquard machine, combined with the power-loom, which, by the latest improvements, is capable of turning out forty-five yards a day; but we may mention that the raw

material of worsted passes through the numerous processes of dyeing or colouring, bleaching, and winding, finally reaching the loom, to be woven up into carpet. The linen and jute also, which form the substratum of the various qualities, are subjected to similar treatment; and it is noteworthy to remark that only the very best materials are used and purchased by this Firm, as well as the purest and most durable of ingredients for the dyeing and colouring department.

Messrs. Morton & Sons have become renowned in connexion with all the leading Exhibitions which have been held in various parts of the world, and have won high honours at each. In the year 1851, that *annus mirabilis*, the Firm sent several splendid specimens to that first and unrivalled of all international Exhibitions; these were followed by exhibits at the Paris Exposition in 1855, the Exhibition held in London again in 1862, and at Paris in 1867. They have also been worthily and successfully represented at the Exhibitions held at Amsterdam, Vienna, and Melbourne; and they have just despatched five superb carpets to the Jubilee Exhibition in Adelaide, South Australia, including one, a Jubilee carpet, which for richness and harmony of colour, superiority of workmanship, and perfection in design and execution has been admitted by manufacturers and connoisseurs alike to be the most



BIRD'S-EYE VIEW OF THE MILLS.

magnificent specimen that has ever been produced by the Jacquard loom in or out of Kidderminster. On the occasion of the marriage of the Prince of Wales in 1863, the inhabitants of the borough decided to present the Heir Apparent with a carpet of special quality and design, and this Firm were entrusted with the commission; and in 1867, when it was resolved to recognise the labours of the Emperor of the French in the cause of free trade between the two countries, they were again selected to make the presentation carpet. The Firm stand unsurpassed in the trade for the excellence of their fabrics, durability of their colours, and the artistic variety and superiority of their designs and productions, aiming as they do to meet the wants and requirements of all the markets of the world, whether Home, Foreign, or Colonial.

Mr. F. W. Lucas, London.

INTERESTING as are many of the industries which, in carrying out the design of this work, we have to describe, there are few perhaps more so than the one to which the present article is devoted; nor could we do better than take the business of Mr. F. W. Lucas as illustrating this branch of manufacture. Established in the year 1844, by the father of the present proprietor, the business has grown from small beginnings until it now holds a leading position in the trade, and supplies the wealthier portion of the community with some of the most elegantly finished, yet withal substantial, vehicles that money can buy or taste and ingenuity devise. Through the courtesy of Mr. Lucas and his manager, our representative was afforded every facility for inspecting the factory, the machinery, and the various processes of manufacture; and a brief description of them can scarcely fail to be of interest to our readers.

We should mention that the principal show-rooms are situated at 451, Oxford Street, at the corner of North Audley Street; but in order to secure ample space for the various departments of the factory, the latter has been located just on the outskirts of London, at the summit of Brixton Hill. Every portion of a carriage is here manufactured with the exception of the axles of the wheels, which, being somewhat heavy, it is found best to obtain from elsewhere. The machinery is quite new, having only been set up some six months or so, and is admirably designed to save labour and insure the utmost precision of workmanship.

In describing the Works we should commence with the Designing-room, which is entered through a large and well-stocked Show-room. In the former may be seen, hung against the walls, full-sized designs of carriages that various customers have ordered; and here the customer can inspect the design, and express his approval or disapproval before the actual work of building is commenced. Provided he express his approval, the next step to be taken is to cut out the wood-work of the carriage according to the design; and we will therefore next take our readers to the shed where the timber is stored. It is hardly necessary to say that ash is the wood principally used in carriage-building; but it may not perhaps be universally known how different are the qualities of this wood that coach-builders can use. English ash is much superior to American,—at all events, for carriages used in our damp climate; but even of English ash the qualities vary greatly. The timber grown in a plantation or wood may be soft and easy to work, but has not the durability of timber grown in the open; and the quality of the wood is affected also by the nature of the soil. Some of the best ash is obtained from the strong clay soil of Worcestershire; and from this and one or two other counties is procured the bulk of the timber used by Mr. Lucas, who is scrupulously careful to obtain the very best quality. Of course it is essential that the wood shall be thoroughly seasoned; and in the timber-shed, which, by the way, is covered over with a roof of galvanised iron and kept perfectly

dry, may be seen timber which has been kept five, six, and even as many as ten years, in order to insure its being in the best state possible for use. The thicker the piece the longer in proportion it has to be kept before being thoroughly seasoned. Mr. Lucas has one of the largest stocks of ash stored by any of the London carriage-makers, and is well supplied also with the other woods required in his trade. Outside the timber-shed, but nevertheless under cover, may be seen large piles of mahogany panels, which are much used by the carriage-builder.

Soon after the plans of the carriage to be built have been approved by the customer, the various pieces of the wood-work are marked out on the planks of ash of which we have been speaking; and great care is taken to follow the grain of the wood as closely as possible, in order to secure strength. A set of tram lines has been laid down in the Works, upon which the block of timber to be operated on is easily conveyed into the Mill-room, as the room in which the greater portion of the machinery has been set up is called. The first of the various machines to be employed in the shaping of the wood-work is the band-saw, with which the rails and other parts are roughly cut out according to the designs, at any angle that may be required. This apparatus is a most useful, ingenious, and efficient machine; nor is it dangerous, as might be supposed, since in the event of the saw breaking there is an arrangement for preventing it from flying out and injuring the workmen. Close to this invaluable machine is another for filing and setting the band-saws; and we then notice an ingenious apparatus technically known as a "Double Spindle Shaping-machine," to which the different parts of the wood-work when roughly cut out by the band-saw are taken, to be more accurately shaped. The spindles of this machine are so arranged that without the slightest difficulty they can be canted over, in order to shape the wood exactly as may be required. By means of the band-saw and this machine together the various portions of the body of a carriage can be expeditiously and accurately turned out at a cost very much below what would be involved in performing the same work were manual labour alone resorted to.

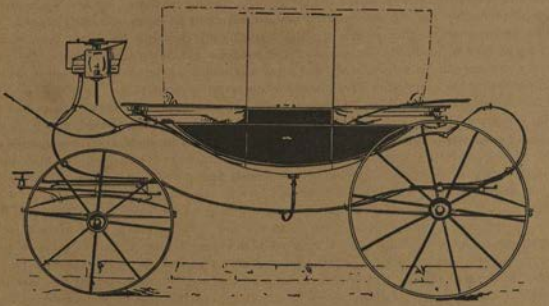
The hand-feeding planing-machine is another useful apparatus, and the more so that it is fitted with an arrangement by which the edges of any piece of wood can be bevelled at whatever angle may be desired. Equally useful is the self-feeding panel planing-machine, by means of which a piece of wood is reduced to precisely the same thickness throughout; it is constructed to plane panels, boards, or planks, varying from an eighth of an inch up to nine inches in thickness. A singularly ingenious boring-machine is attached to the hand-feeding planing-machine, and is so made that holes of any size, and in any position, can be drilled in a piece of wood of any size or shape; indeed, so efficient is this machine, that it might have been thought impossible to do some of the work performed by it except by hand. There is also a drilling-machine for working in iron or steel.

All the machinery to which we have just referred is driven by a gas engine of six horse-power nominal, which appears to give the greatest possible satisfaction, and effects a great saving of expense. The little Engine-room is situated in a corner of the Mill-room, and is worthy of careful inspection by any one going over the Works. Several of the machines to which power is supplied from the gas engine are driven at a very high rate of speed, the planes and spindles making from four thousand to six thousand revolutions per minute, or from sixty-six to a hundred revolutions per second. The machinery is from the Works of Messrs. George Richards & Co., Limited, of Broadheath, Manchester, and London, and appears to be as complete and serviceable as the ingenuity of man can well make it. No accident has as yet occurred in the Works, a fact which speaks much for the orderly and methodical way in which things are conducted.

Passing from the Mill-room into what is known as the Wood-shop, the visitor is enabled to see something of the process of putting together the body of a carriage, the strength of which depends very much upon the edge plate or body plate, as it is technically called. This is a strong piece of steel which follows the shape of the underneath wood-work of the body, and prevents the joints from being unduly strained. A number of landaus, phaetons, broughams, and other vehicles, may here be seen in various stages of completion. The hinges with which the doors of the broughams are fitted are so made as to be entirely invisible when the door is once put on. In regard to the wheels, there are two methods of making the felloes, one by cutting the wood out with the band-saw, and the other by bending it into shape; the former is usually considered the best, as the process of steaming the wood which is necessary before it can be bent renders it liable to split. As a general rule, the wheels of all vehicles in this country are made concave, although in America the custom is different, and they are there usually made flat. Among the advantages which are possessed by a concave wheel are its greater durability, and the fact that in muddy weather it throws the mud outwards; but, as may easily be understood, the utmost precision is required in making such a wheel, since its strength and durability are only secured provided the spokes, passing in turn beneath the centre of the wheel as the carriage

rolls along, are always strictly perpendicular at the moment when they have the greatest weight to support. It goes without saying that in a first-class factory, such as the one we are describing, a point so essential as this is attended to with the greatest possible care, the wheels being made with the utmost precision. An interesting process is that of covering the tops, quarters, and backs of the broughams with leather; for this purpose a single hide is used, which requires to be not only large, but also without the slighest blemish. So skilfully is the hide stretched over those portions of the brougham above mentioned that, in spite of their angular shape, not a wrinkle is anywhere left.

Of the Painting department there is not so very much to be said, except that some thirty coats of paint and varnish are put on the carriages built in this establishment, although the whole layer of paint and varnish together is no thicker when finished than a sheet of note paper. A considerable time is necessarily occupied in bringing the body of a carriage to that perfect condition in which it may almost be used as a looking-glass; and on this account several months must elapse after the order is given before the carriage can be ready for use. Of course, however, there are always a great number of finished and partially finished carriages of every description kept in stock; so that unless something very much out of the ordinary line is required there is no necessity for this delay.



The Blacksmith's Shop is well worth a visit. Here may be seen the process of forging the numerous portions of a carriage which consist of iron or steel, including the springs, which require to be of the very best material and made with great accuracy. Here also may be seen the interesting process of bending the mahogany panels into shape, by means of wetting one side and heating the other, a piece of canvas being glued over the concave side to prevent the wood from splitting.

The Upholstery department is upstairs, and this also is worth a visit. All the best inside cushions, unless otherwise ordered, are covered with morocco, stuffed with the best white curled hair, and made up with thick vellum lace. But carriages may be upholstered in silk, or satin, or velvet, if customers prefer it. The falls for the driving-seats are made of the best canvas and cloth, with fittings of leather; and every carriage is furnished with velvet pile carpets.

Our illustration represents one of Mr. Lucas's "cee" and under-spring canoe landaus, with automaton head, a style of carriage only made by manufacturers who produce the best work. There is no necessity for us to go into details concerning the many ladies and gentlemen of distinction whose carriages have been built at this interesting establishment on Brixton Hill; but if it will in any way satisfy the curiosity of our readers, we may mention the names of the Duke of Beaufort, the Earl of Buckingham, the Danish Minister, the Chilian Minister, and the Countess of Kintore among those who have recently patronised this Firm.

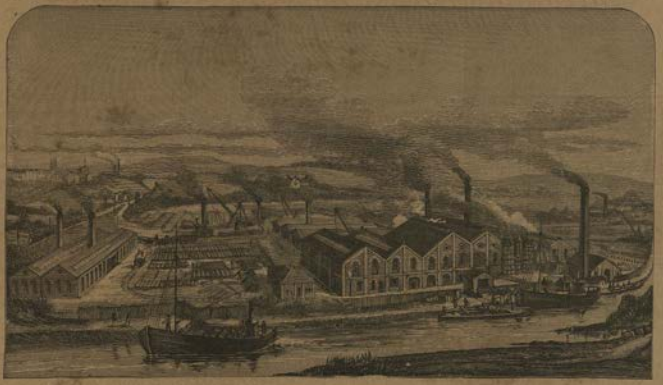
Messrs. Macfarlane, Strang, & Co., Limited, Lochburn Iron Works, Glasgow.

WATER is one of the great necessaries of life, without which the beautiful and complicated machinery of Nature would be rendered useless, and the whole scheme of Creation abortive. Nature, however, has left it to the ingenuity of man to discover means by which the supply shall be distributed where it is most required for the sustenance and development of both animal and vegetable life. Wherever civilisation spreads its influence, the need of an efficient and cheap water-supply is one of the first demands forcing itself upon the attention of the community. In all ages, the construction of water-works and reservoirs has been carried on with energy and various degrees of skill. The science of supplying cities with water from long distances through the agency of pipes and channels is of very ancient origin, and various traces of such work have been but recently discovered in the Holy Land, in the course of excavations for the purposes of antiquarian research. The reservoir and pipe system can, indeed, hardly be improved upon, except in the quality of constructive material, excellence of work, and ability of engineering.

The manufacture of water-pipes is, therefore, a most important and useful industry; and among the leading Companies in her Majesty's dominions which at the present time give their special attention to this work, should be mentioned Messrs. Macfarlane, Strang, & Co., of the Lochburn Iron Works, Glasgow. The business done by them is varied and extensive, and their productions are in demand in all parts of the globe. The manufacture includes every description and size of cast-iron pipes, suitable either for conducting gas or water. The Works of the Company are conveniently situated on the Forth and Clyde Canal, and in close proximity to a branch line of, and have a siding connecting with, the North British Railway. The Canal is the property of the Caledonian Railway Company; thus the raw material required at the Iron Works has the benefit of competitive rates in transit, and the product of manufacture is also conveyed under the same favourable conditions. That this is an important advantage to Messrs. Macfarlane, Strang, & Co. is the more obvious when it is considered that their weekly traffic amounts to several thousand tons. Through the large saving effected in the cost of carriage, the Firm are enabled to give their customers the highest class of workmanship combined with cheapness. At the present time, a large order of 25,000 tons of water-pipes is being executed at the Works for the Manchester Corporation. The pipes are to be used for the purpose of bringing a supply of water from Thirlmere Lake into the city. The engineer for this great undertaking is Mr. G. H. Hill, one of our most eminent hydraulic engineers, and, in carrying out his operations he is employing pipes of very large diameters, forty inches and forty-eight inches interior. Some of the developments shown in the work are particularly worthy of remark. At certain parts of the line Mr. Hill has adopted cast-iron pipes, made plain, like tubes without sockets, the jointures being effected by collars of new and special design. This is looked upon as rather an innovation in engineering connected with water-works, but many experts are of opinion that it is one in

the right direction, as likely to give great strength and security to the mains,—a consideration, which is of the first importance for the success of a water-supply on a large scale. This extensive contract is only one of many with which the Company has been entrusted.

The Works at Lochburn are built on a site of sixteen acres, and some idea of their nature may be gained from the accompanying illustration. The weekly output of manufactured material is close upon 1,000 tons, and about 800 workmen are kept in constant employment. Although the manufacture of cast-iron pipes for the various large cities and towns in Great Britain forms the chief business of this well-known Company, they have, besides, frequently in hand a number of heavy contracts for abroad. Only last year Mr. E. C. K. Ollivant, the Municipal Commissioner for Bombay, placed a large contract with the Company for the manufacture of about 50,000 tons of pipes, required to conduct a water-supply from the Great Tansa Lake to the city. This great scheme is being carried out by Mr. W. Clerke, Engineer of the Bombay Municipality, a gentleman of great experience and ability. The Tansa Lake was, we may say, discovered and surveyed about twenty years ago by Major Hector Tulloch, of the Royal Engineers, who is now engaged



LOCHBURN IRON WORKS.

under the auspices of the Local Government Board, London. Major Tulloch still interests himself in the Tansa water-supply, and has been entrusted by Mr. Ollivant with the general superintendence of the pipes before they are shipped from Lochburn. It is intended to have all the pipes fixed above ground, as the soil is of such a nature that they would be injured by corrosion if put under ground, as is usually done. The interior diameter of each pipe is 48 inches, and the weight of metal about 80 hundredweight. When this large water-service is completed it will be one of the most important in India, and no doubt will redound to the credit of both Engineers and Contractors.

The Firm have greatly benefited by their enterprise on the continent of Europe. They have supplied many thousand tons of pipes for the water-works of Paris, Naples, Boulogne, Oporto, &c., and have made this work quite a specialty. The pipes used are all of French metric dimensions, which necessitated the preparation, at considerable expense, of suitable plant and patterns. The Company have, therefore, in their Lochburn Works all the advantages of an English and a French foundry, enabling them to compete keenly for contracts in any part of the world. The annual deliveries of piping over the continents of Asia and America also form a large and important portion of the work of the Firm. Another notable contract fulfilled by them last year was on behalf of the Government of New South Wales. Altogether,

20,000 tons of forty-two inch and forty-eight inch pipes were supplied, besides several thousand tons of smaller sizes. They were for the New Sydney water scheme, which is to bring a plentiful supply of water to the city from the River Nepean, situated at the foot of the Blue Mountains, and distant from Sydney about forty miles. For many years it had been a difficult problem with engineers in Australia how to successfully cope with the drought from which Sydney suffered in common with other cities of that continent. Nearly every summer it was found that the supply from the Botany Water-works—which had always been looked upon as a model of efficiency—was totally inadequate to meet the requirements of the rapidly-increasing population. Various schemes were tried, but proved impracticable until, at last, the idea of bringing water from the Nepean was successfully carried out. Mr. Moriarty, the Government Engineer, accomplished the task, in the face of obstacles that seemed for a long time almost insuperable. Only a man of untiring energy and courage could have succeeded, and he, therefore, deserves all the credit that can be given. New South Wales, it will be remembered, is a Free Trade colony, whose people believe in the principle of buying in the cheapest market. Its capital (Sydney) is one of the handsomest and most important cities in the Southern Hemisphere, and has a splendid natural harbour. In tendering for this contract they competed with several foreign Firms, and in securing the contract were placed in the position to employ British workmen on behalf of their kindred across the seas. The technical superintendence of the pipes, prior to shipment, was carried out by the well-known engineer, Mr. J. D. Baldry, of Westminster. During their transit to Australia, not a breakage occurred, and the avoidance of any mishap may be looked upon as due to the care exercised in shipment. It is but right to say that the Company make it a paramount obligation to personally attend to the execution of all contracts. During the past two years they have dispatched upwards of twenty large vessels to Sydney, and within the last six months ten large steamers, carrying in all about 35,000 tons of cargo, to Bombay.

THE "BONNA" WATER-METER.

While Messrs. Macfarlane, Strang, & Co. make every description of pipes, they enjoy a distinct reputation for pipes cast vertically in dry-sand moulds, with the socket ends downward, and the spigot ends cut off in lathe. Exceptional care is taken in the mixing of the pig-iron used in the manufacture of these pipes, so as to combine great strength with lasting qualities. The moulds and cores are prepared with the utmost nicety, and the plant is mathematically correct. After the pipes are cut at the spigot ends, they are tested by pressure with oil, which being forced into the pores of the metal, tends to preserve the pipes from corrosion. A coating of preservative solution is then carefully applied.

In addition to the work of cast-iron pipe-making, in which the Firm of Macfarlane, Strang, & Co. are engaged, they have erected special buildings and plant for the manufacture of the "Bonna Water-meter," and have secured patents in Great Britain, France, Germany, Austria, Italy, the United States, and Canada. It is the invention of Mr. A. Bonna, a very ingenious French engineer. It might be desirable to mention that water is sold to householders on the continent of Europe always by measure, and not by an assessment charged on the rental, which is customary in Britain. Hence the demand for water-meters for the Continent is very great and this meter has been specially designed and manufactured to meet all the requirements of both water companies and consumers. The meter is simple and strong in construction, automatic, noiseless, and perfectly accurate in action. The smaller sizes are admirably adapted for use in dwelling-houses; and by the aid of this appliance a check can be kept upon the consumption of the domestic supply of water.

Messrs. Perrier-Jouët & Co., Epernay.

THE wines of the ancient province of Champagne, although not possessing such a lengthy record as their rivals of Bordeaux, have been famed in Europe for nearly five hundred years, since Winceslas, King of Bohemia and the Romans, went to Reims to negotiate a treaty, and drank so excessively that his business was badly done, and he went home a loser. At that time, and for more than two hundred years afterwards, sparkling wines were unknown; nevertheless, creaky, lumbering wagons carried to remote regions casks of red wine from that fortunate district which surrounds Epernay in a radius varying from ten to twenty miles; and when Henri Quatre, having subdued all his enemies, was securely seated on the throne of France, he boasted, amongst all his titles, in preference even to Navarre, that of Seigneur d'Ay.

Monastic institutions, in the Middle Ages, were not merely the home of learning and piety, but also the cradle of inventions; and peoples of a hundred creeds, or of no belief at all, should not forget, when their enjoyment is enhanced by a bottle of champagne, that the discovery of the method of rendering wine more agreeable and more exhilarating, without injurious after-effects, if the wine be properly prepared and carefully chosen, is due to the discovery of a Roman Catholic priest, whilom head-cellarman at the Abbey of Hautvillers, near Epernay. This worthy ecclesiastic, Dom Perignon by name, who flourished in the seventeenth century, taught his neighbours how to render the produce of their vineyards more delicious and more stimulating to the nervous system than heretofore; less injurious and more evanescent even when accidentally taken in excess, by retaining within itself its naturally-generated carbonic acid gas; in a word, he invented Sparkling Wine. The practice of using wood or flax steeped in olive oil, as a bottle-stopper, then commonly in use, as it is to-day in Italy, was found inconvenient; and, therefore, Dom Perignon substituted a cork, for which discovery, considering the magnitude to which the trade has grown, and the high prices which champagne shippers pay, Spanish merchants should be duly grateful. It is not generally known that this corner of France yields for this article a larger revenue to the Iberian Peninsula than any other province; 2d. per cork being the average figure, while 2½d. and 3d. have even been paid.

From these small beginnings in the cellars of Hautvillers the production has gone on increasing, until now, when champagne yields annually about 60,000,000 bottles of sparkling wine, of which 18,000,000 bottles are exported.

The town of Epernay, like Cognac, is small, perhaps about a tenth part of the size of Croydon; but these two insignificant places in France are renowned throughout the world. The good burghers of Epernay are called Sparnaciens, indicating that the noun has changed considerably in successive generations, whilst the adjective probably retains something of its primitive form. The river Marne, on its way to the Seine, waters this fruitful region; rolling uplands of chalk, crowned with vineyards or forests, diversify the scenery on each

side; and beautiful white villages, small in size but famous in commerce, are dotted over the country side, forming a view which, once seen on a brilliant evening in St. Martin's summer, is not readily forgotten. In the new part of Epernay is the Rue du Commerce: there is grouped a collection of palatial edifices, prominent amongst which is the château of Messieurs Perrier-Jouet & Co., of which we herewith present an illustration. After admiring the architecture of the château, we cross the street to the offices, and descend into the cellars, where lie stored several million bottles of champagne, arranged in lofty bins on each side of avenues three miles in extent. The eye becomes weary and the brain exhausted at the contemplation of this huge treasure-house of Bacchus; but our courteous guide, with his genial conversation, prevents any feeling of *ennui*. At the end of our long march we are ushered into a tasting-room, and over a bottle of 1874 glean some information which may be called œnological.

The best white champagnes are made from black grapes, by the simple process of drawing off the must before it has had time to extract the tannin from the husk of the grape. Must from white grapes is sometimes added for blending purposes. The juice of the red grape grown in favoured vineyards, if allowed to remain

PERRIER-JOUËT & Cº. THE CHATEAU

sufficiently long on the husks, and then treated in the fashion which prevails at Bordeaux and in Burgundy, yields a still red wine resembling the latter, with more finesse and less headiness. Nowhere are wine-growers more particular than here in rejecting all unripe and rotten grapes; the system of treading with the feet, still to be witnessed all over Southern Europe, is here superseded by modern presses, and perfect cleanliness obtains in every operation. The grapes are pressed three and even four times; the first pressings being naturally the best, and the last the worst. Hence arises the wonderful discrepancy between the prices of champagne, albeit from the very same village. Firms of the highest standing, like Messrs. Perrier-Jouët & Co., and a few others whose names are synonymous with excellent quality, sell to speculators their later pressings, and these poor, thin, flavourless wines are either sold for local consumption by the poor, or, labelled with fancy names, are sent abroad. In England one may sometimes see at hotels or in wine merchants' windows the legend "A Real Epernay Wine, 36s. a dozen," and the statement may be true, although more frequently than not it is otherwise. Persons who love economy above all things may consume these beverages, but they are assimilating into their organisms only the drink of peasants.

After the new wines have remained five or six months in cask, they are bottled; and the preliminary cork is secured in each bottle by an iron clip called an *agrafe*. The bottles are then binned, and allowed

to repose for about two years in a horizontal position. Needless to say that the owner of a stock worth several hundred thousand pounds does not leave it without careful supervision. A change of temperature, even a sudden current of air, may break hundreds of bottles; so that during warm weather it is often necessary to remove the wines from the upper cellar, and send them down a floor or two lower. When the tartar, and other impurities of the wine are deposited in a greyish stratum on the side of the bottles, the latter are very carefully removed, and placed in *pupitres*; i.e., desks with holes bored in them to hold the bottles at an angle of about 40 degrees. By the attraction of gravitation the bulk of the deposit descends from the side of the bottle on to the cork; but some of it adheres, and in order to remove this numerous workmen are daily employed in agitating the bottles. It is said that a skilful manipulator can operate upon 30,000 bottles a day; and, judging by the celerity of their movements, this assertion may be credited. This work is continued for about six weeks, and then begins the interesting process of disgorgement, which consists in removing the *agrafe*, and allowing the cork to escape, behind which follows the impurity collected at the mouth of the bottle. By a dexterous turn of the wrist, the workman elevates the bottle exactly at the moment when all the waste has escaped, and no wine is lost. Another workman adds the liqueur, which is composed of wine, finest old Cognac, and candy sugar, carefully blended. For fine wines not more than two or three per cent. of this adjunct will be required; but for the cheaper kinds, and the later pressings, much more often to be met with on the Continent than in England, ten and even fifteen per cent. of liqueur is sometimes needed. British taste has for years past been in favour of dry wines; and thus, when dealing with a respectable firm, the Englishman obtains better value than his Continental neighbours. The liqueur being added, another workman drives in a cork, twice as big as the neck of the bottle, by the aid of a machine which compresses the cork as it descends. One can always tell whether wine has been newly landed by examining the cork; if recently inserted, it swells towards the bottom almost to its original size, and presents a conical shape; if the wine has been landed a long time in this country, the end of the cork retained in the neck is hard and round. The cork is then secured by wire and string, after which it is carried in baskets to the packing-room, where it is adorned with gold foil, labelled, and placed in cases or panniers according to its destination.

The business of Messrs. Perrier-Jouët & Co. was established in 1813; and by degrees it has grown until it has attained its present leading position. England has always been their great market; but the American and Colonial demand for their brand is now rapidly growing, and in America in particular the consumption of this wine has increased from 660 cases in the year 1880 to 15,536 in 1886, or more than twenty-fold. The Firm have agencies in New York, New Orleans, and Montreal, as well as in London and all the European capitals.

Messrs. John Symons & Co., Totnes.

HERE are few fruit-trees more widely diffused over the face of the earth, and more extensively cultivated than that of the apple; and, in the opinion of many, there is no other fruit-tree of equal value to mankind. It succeeds best in the cooler portions of the temperate zone, but is to be met with in parts of the world so different in character and so distant from one another as Arabia, Norway, Canada, and the West Indies. As a wild fruit, the apple is indigenous to England, and is also found as far north as Drontheim and Siberia; but the cultivated variety is supposed to have been introduced into this country by the Romans, by whom it was largely grown. There can be no doubt, however, that originally all the varieties of apple came from one common stock. Of the better-known kinds there are some which are considerably more hardy than others, and are therefore selected for exposed situations; while some, again, especially those of the finest kinds, are more tender, and only succeed well provided the soil and climate are both good.

As a district peculiarly suited both by climate and by soil for the cultivation of the apple, it would be hard to beat the south-western counties of England, including among them in particular Devonshire, Somersetshire, and Herefordshire, where the soil is rich and the climate mild, and apple orchards abound. Devonshire, perhaps, of all the English counties, is the leading one in regard to the cultivation of this valuable fruit and the manufacture of cider; and the first British orchard is said to have been planted at Plympton in that county. For centuries the cider of Devon has been famous, although it is but quite recently that the process of cider-making has been conducted either there or anywhere else on scientific principles. In former times it was hardly possible for this to be done, as the manufacture was not carried on to the large extent which it has now reached, and was usually conducted by each apple-grower for himself. Westcote, who wrote rather more than two centuries and a-half ago,—that is, in the year 1630,—in his book entitled "View of Devonshire," refers to the "making of cider, a drink both pleasant and healthy; much desired of seamen for long southern voyages, as more fit to make beverage than beer, and much cheaper and easier to be had than wine." In the last century a treatise on cider-making was written and published by an ancestor of the late Lord Iddesleigh. Its title ran as follows:—"A Treatise on Cyder-making, founded on long Practice and Experience, with a Catalogue of Cyder-apples, &c. By Hugh Stafford, Esq., of Pynes, in Devonshire. 4to. London: 1753." It was during the last century, too, in 1763, that a great ferment was caused in Devonshire by the imposition of an excise duty of four shillings per hogshead on cider. The tax, however, was shortly afterwards repealed.

The different varieties of apple in cultivation are extremely numerous, and have been carefully classified by German writers, who have treated the study of apples and kindred fruits as a science, and distinguished it by the name of Pomology. Fresh varieties are continually being produced; and, at the present time, there are said to be some two thousand distinct sorts in existence. But of these there are certain kinds which

are specially suited for cider-making, among which we may enumerate those known in the south-west as the Yellow Satyre, the Late Bloomer, the Buffcoat, the Butter-box, the Hangdown, the Kingston Bitter, the Broadie, the Dupplin, the Royal Redstreak, the Pocket Apple, the Green Bitter, the Beech, the White Normandy, the Fox-whelp, and the Royal Wilding. The district surrounding Totnes, in South Devonshire, is admirably adapted for the cultivation of these varieties, as indeed it is for that of the apple in general; and, what is of some importance also, the atmosphere in that part of the county is particularly favourable for developing the flavour of the apple, and for the fermentation of light alcoholic liquors. It is hardly possible, therefore, to imagine a spot better suited than Totnes for the manufacture of cider on a large scale. To this town as a centre pour in the apples from all the cider-country around; and here they are first sorted with much care, and then mixed in the right proportions and crushed. As the town is favourably situated on the Great Western Railway, and also has water communication by means of the River Dart, the cider trade of South Devon naturally centres here; and Totnes is now the head-quarters of the cider-making industry in this country.

There is no necessity in an article of this kind to write a history of the place where the business under notice is conducted; but, at the same time, when historic associations are connected with it, a word or two on the subject may not be out of place. The municipal borough of Totnes, which is the chief town in the district of South Devon known as South Hams, is one of the most ancient of the towns of Devonshire; and, although its early history is involved in obscurity, there can be no doubt that, at a very early period, the tin of Dartmoor was exported hence to the neighbouring continent. A tradition is current that Vespasian landed here on his way to the siege of Exeter; and whether that was the case or not, Roman coins have from time to time been found in different parts of the town.

During the Anglo-Saxon era there was a Mint at Totnes; and in the Royal Cabinet of Antiquities at Stockholm twenty-one specimens of the coins from this Mint may be seen. At the Conquest the manor and lordship were handed over to a Norman baron, to whom also were consigned no fewer than a hundred and six other manors. From the reference to Totnes in Domesday, we learn that there were ninety-five burgesses within the borough and fifteen without, and that they were taxed only when Exeter was taxed.

At one time the town could boast of a considerable trade with France; and six or seven hundred years ago its woollen manufactures were in a flourishing state. There are many objects of interest to the antiquary in the place, as, for instance, the church and the ruined castle; the Guild Merchant of Totnes Records go back as far as the year 1260, and the Roll of Mayors is complete from 1377, the present Mayor being the five hundred and tenth.

As Totnes is the centre of the Devonshire cider district, and enjoys such admirable facilities for the shipment of goods, most of the cider for exportation is made either here or under the superintendence of the principal Firm of the place, Messrs. John Symons & Co. To this Firm belong numerous cider stores in various parts of the country, of some of which we give illustrations. As in the case of so many industries, so, too, with the manufacture of cider, it has been found in recent times that operations can be conducted on a large scale more economically and successfully than on a small one; and, consequently, the cider trade has gradually become concentrated in a few hands. Some half-dozen or more of other Firms have, one after another, made over their businesses to Messrs. John Symons & Co.; and as one of these had been established for more than a century, it may now be fairly said that Messrs. Symons & Co. are carrying on the oldest business in the trade.

The organisation which is possible only in a large concern, and of which this Firm have been careful to avail themselves, has doubtless had much to do with the great success they have achieved; by means of the most thorough and methodical organisation, they have been enabled to practise economy in regard both to material and to labour, and thus to compete successfully with other manufacturers. As a proof of the enormous business done by the Firm, we may mention that in a single year they turned out no less than 10,000 hogsheads of cider, and that their annual output at Totnes Mills and Tuckenhay amounts to 6,000 barrels, exclusive of what the farmers send in, while still in a crude state, to be converted into an article fit for the market. Such dimensions would never have been attained by their establishment had they not given the most constant attention to all the working details, and had they not always endeavoured to supply the public with only the best article that could be made. They have also been possessed of a clear insight into the conditions and wants of the trade, and have not been lacking in enterprise when suitable occasion offered.

To Henry Symons, Esq., J.P., the present proprietor of the business, is due in a great measure the remarkable prosperity of the concern. Mr. Symons, who by the way is the Mayor of Totnes for the current

year (the 510th Mayor above alluded to), has not been content to follow the primitive and unscientific methods of manufacture which were adopted by successive generations of cider-makers before his time; he has studied the subject in a scientific spirit, and has carefully applied the results of his researches to the furtherance of his business and the improvement of the article which he offers to the public. Before his time a rule-of-thumb system had always been followed in a blind sort of way, which, although under certain circumstances it might give satisfactory results, under another set of circumstances would be attended with utter failure; nor were the farmers and the small houses by whom the cider was made in this primitive and unscientific fashion in a position to account for these frequent failures, or to guard against them. Mr. Symons, however, investigated the chemistry of fermentation; and thanks to him the nature of this process is now understood, and the desired results can be secured with almost absolute certainty provided only the requisite care be taken. In the establishments of the Firm under notice the manufacture of cider is now carried on, not only under a system of the most thorough and efficient organisation, but also on scientific principles; and it is not therefore surprising that the business has grown until its present extent has been attained.

As we have said, Messrs. Symons & Co. have large numbers of cider stores in various parts of the country. In Totnes itself they own six or seven extensive stores or other premises; and these are supplemented by others at Paignton, Tuckenhay, Buckfastleigh, Newton Abbot, Exeter, &c., where the farmers bring the newly-pressed juice, or must, of the apple to be fermented and fully prepared for the market. The Totnes establishments are all substantially built of stone, and are situated either in or close around the town. Half a dozen of them are located beside the River Dart, whilst one has been erected alongside the Great

Western Railway, near the station; so that every facility is enjoyed for the shipment of goods to all parts. On the floors of the various buildings may be seen innumerable pipes of partially-fermented cider; here the process of fermentation goes on, and is at times either accelerated or retarded by the men in charge as circumstances require.

The situation of the Firm's Works is admirably suited for commercial purposes. The fruit is brought in by means of a siding, on the very trucks on which it was loaded in the various apple districts; while the river affords every facility, not only for shipping the cider by steamer or sailing vessel to Liverpool, London, or elsewhere, but also for importing apples from Normandy. The Firm have stores and a quay just beyond the town limits, where cargoes can be loaded or unloaded free of all dues. It should be mentioned by the way that the mixing of apples grown on different soils is a matter which receives the most careful attention from the cider-maker, just as the products of different vineyards are blended with the utmost nicety by the manufacturer of wine. Much of the excellence of the cider depends on the skill and judgment with which the mixing process is conducted. The Totnes Works of Messrs. Symons & Co. form a kind of centre towards which the cider apples of all the neighbouring districts, including parts of France, appear to gravitate. In the building where they are crushed, an abundant supply of pure water has been secured, which is a point of considerable importance, as a large amount is wanted for cleansing the numerous casks and other vessels used in the manufacture of cider. This water supply is obtained from the neighbouring hills, and rises of its own accord to the highest parts of the building. By an arrangement of pipes the cider can be distributed without labour from this establishment to any of the adjoining stores.

When the apples are brought in, provided they are properly matured, they are immediately emptied into a large bin, whence by means of an endless-chain elevator worked by steam-power they are raised to the top of

the building and dropped into the crushing-mills. If not sufficiently matured when received, they are stored in bins, in the same part of the building, until ready for sorting and crushing. The steam elevator, as well as the hoist by which the unmatured apples are raised, is kept very busy during the season at which the apples are brought in. Formerly the crushing was accomplished by means of a stone, weighing about a ton, which was drawn over the apples; but the modern crushing-mills, as used in the Works of Messrs. Symons & Co., are of very different construction. There are four of these, which are worked by steam. The essential part of the mill consists of a cylindrical barrel, wherein are contained several graters or knives, revolving no less than forty-one times per second. By means of these machines the fruit is quickly reduced to a fine pulp, technically known as "pomace," which falls into enormous tanks below. The great object to be aimed at in performing the pressing operation which follows is of course to break every cell, and extract every drop of juice. To do this literally would be impossible; but with the help of the powerful Boomer presses very satisfactory results can be obtained. These machines were fitted up by Messrs. Head, Wrightson, & Co., of Stockton-on-Tees, and by their means a pressure of 150 tons can be secured. As the pulp, wrapped up in strong cloths, is subjected to this operation, the juice oozing out runs down into three enormous cisterns below; hence it is pumped into other cisterns in the upper part of the building, and drawn off into casks to be racked.

We ought to mention particularly that the tubes through which the liquid is pumped are glass-lined, and that throughout the process of manufacture scrupulous care is taken to avoid metallic contamination. When the density of the juice is found to be less than it should be, the deficiency is made good by the admixture of a substance manufactured by Mr. Henry Symons, which at the same time increases the strength and flavour of the cider. The process of fermentation takes place in the casks already referred to, which are left open at the bung, and each of which is periodically examined. The temperature and ventilation of the stores where the fermenting liquor is placed require to be carefully regulated. To ascertain how the fermentation is progressing, a lighted candle, attached to a stick, is inserted through the bung-hole; should the process be found to be going on too rapidly the cider is emptied into another cask; on the other hand, should the process be proceeding too slowly, the temperature may sometimes have to be raised. It is an important point, however, that no chemical or artificial method, except the usual fumigation of the casks, is ever resorted to by the Firm in order either to regulate the fermentation or to improve the colour. Three or four months are usually required after the juice is expressed from the "pomace," before it is brought to the perfect condition in which it is sent out as cider from the Works of Messrs. Symons & Co.

All through the process of cider-making the most unceasing care is necessary on the part of the maker. The apples, to begin with, must be mature before being crushed; and they must also be of the right kinds and mixed in the right proportions. The moment the juice has been extracted and fermentation has begun, constant watchfulness is necessary in order to see that all goes well; and indeed it is said that in no other branch of manufacture of a similiar nature is such careful and constant attention to the half-formed product required. Hence we find that in the Works of Messrs. Symons & Co. the fermenting process is allowed to go on in casks, and not in large cisterns, since the former are so much more easily and efficiently attended to. Some 20,000 casks altogether are used by the Firm, who naturally, therefore, have their own cooper's shop on the premises. An apparatus is kept for cleaning by steam the casks, the pumps, and the various vessels in use in the establishment.

Provided all goes on satisfactorily, the cider is drawn off in the spring to be sent out, either to the trade generally or to the Firm's stores in London and Liverpool, both of which cities, fortunately, can be reached by water. The residual product, or "mock" as it is called, which is left behind when the juice is expressed from the pulp, has received much attention from Mr. Henry Symons, who has proved himself possessed of a wide chemical knowledge in investigating the matter. His conclusion is that it may be turned to good account as a manure after being put through a proper course of treatment; and accordingly he is preparing the "mock" from his Works for the purpose. But perhaps Mr. Symons's greatest success has been achieved in connexion with the devising of new beverages, of which the base is the juice of the apple. Among these are Messrs. Symons & Co.'s Champagne and Moselle wines, which have much better keeping qualities than cider, and possess a sparkle and flavour which make them dangerous rivals even to real champagne itself. They are put up in champagne bottles; and both these and the Firm's cider have been shown at some of the leading Exhibitions, including those at Calcutta, Paris, and London, and have received the highest awards for sound-keeping qualities, flavour, richness, and purity.

The Levant Cigarette Manufactory, London.

AN authority on Cigarette-smoking states that the demand for Cigarettes in the United Kingdom alone is estimated at 8,000,000 per diem, and, with that datum, the number made by consumers themselves may be put down at about 20,000,000 a day. In other countries Cigarette-smoking makes a still more prominent appearance in the statistics of tobacco. In France the Cigarette is the popular mode of smoking, while the pipe or the cigar is mainly preserved for clubs or private houses. The consumption of Cigarettes in France is estimated at 105,000,000 a day. Germany has long been a Cigarette-smoking country, and the Saxon capital boasts of one of the very largest factories of the article in the whole world. In Turkey and the Levant, and also in Egypt, the Cigarette is extremely popular, and in Spain, Portugal, South America, and the United States, the consumption is prodigious. In England the pipe and the cigar still bear sway among tobacco smokers, but they are no longer supreme. The once-lowly Cigarette is fast making its way, with the consciousness that it possesses qualities that must insure for it a long and successful future, until human ingenuity has devised some still more advantageous way of enjoying the fragrant weed; and it is now becoming as popular and as general in this country as it is abroad.

There are fashions in Cigarettes which are constantly changing. A few years ago, the stiff mouthpiece was considered a great improvement, but now one seldom sees that special make of Cigarette, although it is very much sought after in Russia. Most English Cigarette-smokers possess holders of meerschaum and other substances, and those who do not care for cigarette-holders, object to the mouthpiece on account of its liability to break off when the external layer of paper becomes moistened.

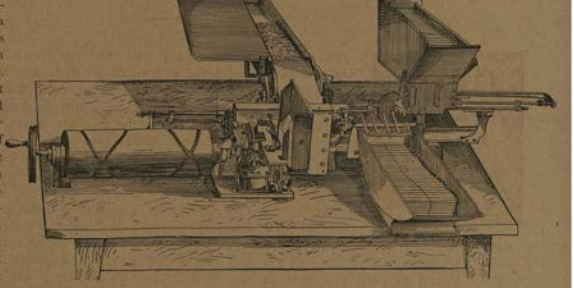
The competition of manufacturers has resulted in a great improvement in the quality of the tobacco, the lighter grades of tobacco, in which the percentage of nicotine is low, being in general use, and the public has been gradually weaned from its taste for the darker Virginian tobaccos, in which a large proportion of nicotine is present. The paper now used by all the leading manufacturers may be said to be perfect. A Cigarette comes to the mouth clean and fresh, and must be better for the health than the pipe, which gets fouler with nicotine after every use, until the smoker has to hold it up every now and then to let the nicotine drain out of the stem. The Cigarette is now to a great extent taking the place of the pipe. It is not uncommon to see a labouring man puffing a Cigarette, in place of what was once the "eternal" pipe. And many ladies, who would shrink with horror from a pipe, have sufficient courage to take a few whiffs of mild Turkish tobacco smoke from a Lilliputian Cigarette.

The Turkish Empire has long been known as producing some of the finest tobaccos in the world. In the Sanjac of Drama, which forms the Vice-Consular district of Cavalla, tobacco is the staple article of production and industry, and some 75,000 acres are devoted to its culture. The tobacco of this district, though derived entirely of one species, is divided into two classes, known as Drama and Yenidje. The former leaf is larger,

stouter, and more potent, and generally of deep reddish-brown colour. The latter is smaller, slightly less narcotic, with a peculiarly delicate aroma, and the best is of a rich yellow colour, whence its name of "golden leaf." The Drama kind is principally grown in the western portion of the district. The differences in the two kinds of tobacco seem to be due solely to the soil.

Encouraged by the increasing demand for Cigarettes, the Levant Cigarette Manufactory, of 56, St. Mary Axe, have purchased the patent rights of a beautifully-constructed Cigarette-making machine, the invention of a French gentleman, Monsieur Perrot-Minnot. An expert Cigarette-maker will turn out by hand about 1,000 Cigarettes a day. This admirable contrivance is capable of making twenty times that number, thus reducing manual labour to a minimum, and enabling the Manufactory to sell Cigarettes at an astonishingly low figure. The business of the Levant Cigarette Manufactory is carried on in a most systematic manner, and every precaution is taken to obtain perfect purity, both as regards tobacco and the paper in which it is rolled.

At the top of the factory in St. Mary Axe, the bales as they are imported from Yenidje are sorted by women under the superintendence of a skilled Russian, who is a perfect judge of rare qualities of tobacco. These qualities are determined by the colour and condition of the leaf. Some are cut too soon, while others are gathered too late. Occasionally, the Russian in charge of the sorting department is obliged to smoke a little of the leaf before it goes to the cutting-machine, in order to judge of its quality. In Turkey all tobacco is cut by a hand knife. A good workman will cut from fifty pounds to sixty pounds of leaf a day. Very little tobacco is cut by hand in London. The Levant Manufactory employ Legg's tobacco-cutting machine, which can be adjusted to cut the leaf to any thickness required. If cut too thin, however, the tobacco loses some of its aroma. Legg's machine will cut fifty pounds an hour, just the quantity operated upon by a quick workman in a whole day by the hand knife. After the leaf is cut, the tobacco is sent to the Cigarette-making machine, which is worked by one of the celebrated Otto Gas Engines. All M. Perrot-Minnot's machines used by this Manufactory are under the direct supervision of the inventor, who is a mechanic of great skill. At one end of the machine the paper tubes are received, and at the other extremity the cut Turkish tobacco. The engine is started, and the Cigarettes fall into a well at the rate of 3,000 an hour. M. Perrot-Minnot exhibited his ingenious machine at the St. Petersburg Electrical Exhibition, and the Emperor of Russia was so struck with the clever contrivance that he purchased one for the Palace, where it is now used for making Cigarettes for the Czar and his friends. The Levant Cigarette Manufactory have the sole right to use or sell these machines; no other Firm can employ them without a licence from the owners of the patent.



The Levant Cigarette Manufactory produce all their cheap Cigarettes by machinery, but the best qualities are still made by hand. Although only the very finest Turkish tobacco is used, this Manufactory make Cigarettes strong enough to satisfy those inveterate smokers who still cherish the pipe. Many persons are under the impression that Turkish tobacco is so exceedingly mild that it is only fit for boys and ladies. It is true that certain kinds of tobacco grown in Turkey are mild enough to satisfy even the fair sex, but, judging from some of the samples sent us by the Levant Cigarette Manufactory, old smokers might easily take to Cigarettes without losing any of the solace they derive from the unsightly pipe. Men of all professions could smoke a Cigarette in the streets without attracting attention, but what would be said of the divine or the family doctor who made his morning calls with a short clay in his mouth!

Messrs. H. I. Rowntree & Co., York.

UNIVERSALLY acknowledged as it is at the present day to be an agreeable and wholesome drink, it is amusing to recall that Cocoa, when originally introduced as a beverage, became the subject of strong agitation and warm contest. Approaching in its original form and in its alimentary properties so nearly to solid diet, it was doubted by the timid and devout, whether enjoying so delicious and invigorating a luxury in Lent and other seasons appointed for fasts, was not violating a sacred ordinance. The point thus involved gave rise to much wordy strife, and the Church Fathers were quoted *pro* and *con*, according to the sides which the several parties took. A Spanish physician wrote a learned treatise in Latin, under the title of "Tribunal Medico-Magicum," against what he considered an impious practice. He was answered by a Cardinal of the Catholic Church, who urged that the drinking of cocoa or chocolate could not be construed into breaking a fast. The matter gradually blew over, and from that day to this cocoa and chocolate have deservedly held their own as highly nutritious beverages, both milder and less stimulating than either tea or coffee, and thus more conducive to health.

What has materially helped to popularise this article of diet is the improvement which has taken place in its quality. Some thirty years ago Dr. Lindley pointed out that good cocoa was never made in this country, indeed the best qualities of chocolate as well as cocoa were at that time only made in France and Spain. Happily all this is now changed, and amongst those who deserve credit for having brought about an improved state of things are Messrs. H. I. Rowntree & Co., of York. Their business, which was established in 1838, has just completed its Jubilee, and finds thus an appropriate place in these pages.

The two Factories at York form together a very extensive block of buildings, having been enlarged again and again during recent years, in order to keep pace with the increased requirements of this prosperous concern. One block after another of adjoining property has been acquired and incorporated with the Works, which form now a conspicuous feature noticeable from several parts of the city. From the very beginning of their connexion with the business, Messrs. Rowntree made it their special object to produce an article that should be superior to the majority of those in the market; and they rightly concluded that this laudable end could be only attained by employing the best workmen, the most improved machinery, and what is not less important, the very finest qualities of cocoa beans. Equally conducive to the realisation of their aim was their resolve to be content with a moderate rate of profit on their invested capital. By the conjoined action of these several factors, the Firm have succeeded in building up a high and well-merited reputation, so that their productions find a ready market in America and the British Colonies as well as in the United Kingdom. Their aim has been to make the English consumer independent of French sources of supply, whence at one time all the finest chocolates had to be imported, while now, it is highly gratifying to know, even the best varieties can be obtained of British manufacture.

Messrs. Rowntree find it necessary to import the finest brands of cocoa, such, indeed, as are rarely placed upon the London market, being above the standards of those in demand in Mincing Lane. The various samples of the several varieties selected are examined, and roasted separately, to ascertain the peculiarities of flavour by tasting. The particular brands desired for converting into prepared cocoa having been selected, the beans are first roasted until the aroma is properly developed. They are next passed between rollers, which break the nut and thus loosen the shells. The nibs are then passed through a winnowing machine, by the aid of which the shell is separated, and the nib thus freed drops into a reservoir provided for the purpose.

For the manufacture of chocolate, the nibs, together with due proportions of sugar and vanilla, are next placed in a "mélangeur." This consists of a revolving granite pan, in which, by means of two granite wheels or runners, the whole is well crushed and mixed. Perfectly as this operation appears to be performed here, a second machine of a somewhat different character is provided, to insure that not even a grain of sugar or cocoa shall remain without being completely crushed and embodied in the paste. The latter machine is not unlike a steam printing-press in appearance, only that instead of the cylinders granite rollers are provided, between which the mass is repeatedly passed. There are subsequent manufacturing processes, but to describe some of these would be betraying trade secrets. We may, however, say that wherever possible machinery is pressed into service, and some highly-ingenious appliances were in active operation on the occasion of our visit to the Works. Among the various special arrangements which we noticed was a powerful refrigerating machine, the temperature in which can be brought down to 57 deg. below zero. An apparatus of this description is of the utmost importance in connexion with the manufacture of the various preparations of chocolate produced by the Firm, since it enables them to carry on operations throughout summer the same as in winter.

In passing through the large and airy workrooms the visitor is greatly impressed with the neatness and cleanliness which prevail everywhere. This remark applies equally to the rooms, the utensils and machinery, and the men and women employed. After having inspected the various manufacturing departments, one reaches the large store-rooms, where the different classes of goods are all arranged in proper classification. The Firm's productions include every variety of cocoas, chocolates, and the finest French confectionery, and embrace altogether some two hundred distinct classes of goods. In addition to the ordinary range of manufactures, there are many specialties, and chocolates in almost endless variety. These several productions are done up in very tasteful style in fancy boxes of elegant appearance and dainty finish; and it will, perhaps, give some idea of the great diversity of goods produced at the York Cocoa Works if we mention that the boxed chocolates and sweetmeats in question are adapted to every class of trade, to be retailed at from one penny up to three guineas per box.

Special mention may be made of Messrs. Rowntree's Prize Medal Rock Cocoa, which is composed of pure cocoa and sugar only, and contains a much larger proportion of cocoa than do even the finest of foreign chocolates. Never content with past success, constant efforts are being made to attain a higher standard of excellence; and as somewhat illustrating the time and thought which are devoted to the business, we may mention that for some ten years the Firm have been experimenting and bringing to perfection an Extract of Cocoa which is just being introduced to the trade. This Extract the result of costly and protracted experiments, will it is believed be widely popular.

On the occasion of our visit to the York Cocoa Works we were greatly impressed with the evidence of energy and enterprise manifested on every hand; the acting partner of the Firm apparently sparing no effort to insure for the business over which he presides a continuance of that high reputation which it has now for many years enjoyed.

How greatly the consumption of cocoa has increased in this country during the last half-century, will be seen from the fact that about the time when the business under notice was established the consumption per head of the population was only a quarter of an ounce, while now it exceeds on an average six ounces for each inhabitant. The Customs duty, which was half a century ago sixpence per pound, is at present only one penny. Finally, it is worth mentioning, that whereas at the earlier date the total importation into the United Kingdom amounted to only 2,118,000 lb., we now import over 23,000,000 lb. per annum, of which total about 14,000,000 lb. are retained for home consumption. By producing an excellent article at a reasonable price, Messrs. H. I. Rowntree & Co. have contributed their share in thus popularising this wholesome and palatable beverage.

Messrs. Ralph Heaton & Sons, Birmingham.

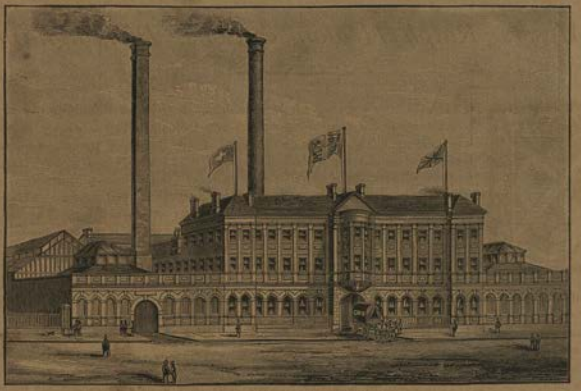
OWADAYS it is not easy to form an adequate idea of the difficulties to which our commerce was once exposed from defective Coinage. The deficiency of small change interfered with the legitimate dealings of all classes of traders, who, in order to somewhat obviate the evil, had recourse to "tokens," and it has been computed that in London alone, in the early part of the seventeenth century, some 3,000 tradesmen issued "leaden tokens," bearing their several names; while the same practice was also largely followed in other parts of the kingdom. The inconveniences of this system need hardly be pointed out; every petty tradesman issued such pledges, which were supposed to be payable to bearer on demand; but it depended, of course, upon his honesty and financial status whether the token was of more than nominal value, or was ever redeemable. The extent to which this evil had increased may be inferred from a proclamation issued by Charles I. in 1625, setting forth that "Whereas his late Royal father took order that instead of unwarranted farthing tokens, till then used by vintners, chandlers, tapsters, and other retailers, to the loss of his loving subjects, there should be others made by his own warrant, under his own Royal name and inscription, and a constant re-change settled, whereby the subject might have the lawful use of them with much ease and without loss." This would appear to be about the earliest mention of copper coin issued by authority. A few years later a patent was granted by the king to Lord Maltravers and Sir Francis Crane "for the sole coinage of copper or brass farthings."

Despite, however, the relief which it was thus sought to effect, the English Coinage continued very unsatisfactory. "Tokens" were again and again brought into requisition as a medium of small change, and in Birmingham alone, during one decade towards the close of the last century, about 700 tons of copper were converted into tokens. It was not until just seventy years ago that the manufacture and issue of token money was made illegal by Act of Parliament.

The more general introduction of copper coin opened up a new sphere to the enterprise of Birmingham manufacturers, and to Matthew Boulton belongs the credit of having been the first to take up this new industry, if such it may be termed. From his works at Soho, the fame of which has for many years past survived only by tradition, was issued towards the close of the last and at the beginning of the present century, a large quantity of copper coinage, which has, however, long ere this disappeared, having been replaced by the greatly superior bronze money with which we are all familiar.

When, in 1850, the machinery and plant of the Soho Works were sold off, nearly the whole of it passed into the hands of Messrs. Ralph Heaton & Sons, a Firm that has been in existence since the latter part of the last century. By them the process of Coining has been largely remodelled, and brought to a degree of perfection in each of its many departments, such as was never dreamed of by the pioneer of the Craft, whose direct successors Messrs. Heaton may indeed claim to be.

Mr. Ralph Heaton, the founder of the business, and the grandfather of the present head of the Firm, was an exceptional genius, in whom the inventive faculty had been strongly developed. Some of his inventions in the form of machinery have never been superseded, and survive to this day. He was the originator of the hot shot used at the siege of Gibraltar in 1783, and Lord Heathfield, who (as General Elliott) was in command at the time of the siege, speaking of him to some friends when he visited Birmingham, said, "This is the man who saved Gibraltar." The present Mr. Ralph Heaton (the third bearer of the name), whose portrait is given on next page, was born on April 26, 1827, and was educated at the High School, Handsworth, and the Aldridge Grammar School, near Walsall. Having completed his education, he joined his father, who was then in business as brassfounder, stamper, and metal-tube manufacturer; and the last-named branch of business is still carried on by the Firm on a very extensive scale, as we shall have occasion to point out later on. Endowed with rare talents and great mental gifts, Mr. Ralph Heaton has built up, and now presides over, a business which may proudly claim not to have its equal. Nor is Mr. Heaton less remarkable



THE MINT, ICKNIELD STREET, BIRMINGHAM.

for his geniality of manner and private charity than for his liberality towards his large staff of employés. He has devoted much of his time to the furtherance of local improvements, and has filled the offices of Town Councillor and Alderman with great credit to himself and with much benefit to his fellow townsmen. About three years ago he was, by reason of the many calls upon his time, compelled to relinquish his connexion with the Town Council. He still, however, fills with marked advantage the offices of Magistrate for the County of Stafford and for the Borough of Birmingham. He is also Trustee of various Charities, and continues to identify himself with every progressive movement throughout the district.

Originally the Firm's Works were situated in Shadwell Street; but with the great development of the business, these were found inadequate, and, in 1860, the present magnificent block of buildings in Icknield Street was erected. Some idea of their extent may be gathered from the above illustration. Locally they are known as "The Mint," and they well deserve that expressive title; for from hence has been issued not only a very large proportion of our own Coinage, but also the circulating medium in use now, or at some former time, or both, throughout most of the kingdoms and republics of the habitable globe. This simple statement speaks volumes as to the extent of the business done; while the interior organisation of the factory, and the many improvements effected from time to time in the machinery employed, no less than the precision and finish of the coined money, all alike attest the enterprise, the ability, and the experience which are brought to bear

upon the work. For a long time Messrs. Heaton's Mint was the only private establishment of the kind in this country, and even now it may be safely affirmed that they still stand out foremost from among all competitors.

As affording some notion of the scale on which the process of Coinage is carried on, it is worth mentioning that in 1860 our own antiquated copper money was replaced by bronze coin, and that no less a sum than £1,709,753 sterling has thus been issued down to the year 1885, which is more than double the amount of the old copper coin estimated to be in circulation at the earlier date. What this signifies will, perhaps, be better understood when we remind the reader that 240 pennies, 480 halfpennies, and 960 farthings respectively, make up one pound sterling. The weight of the bronze coinage implied by the above figures amounted to several thousand tons! Apart from this, however, Messrs. Heaton & Sons are largely engaged in coining the precious metals, and only a few years ago they delivered to the Royal Mint for

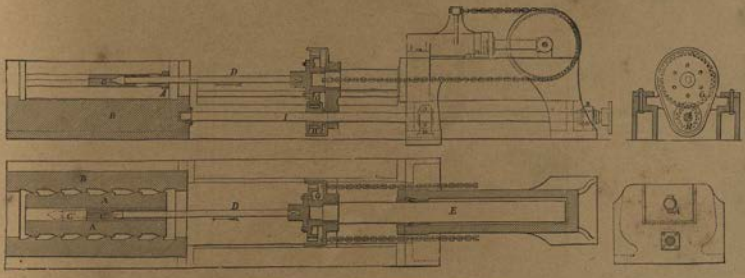
MR. RALPH HEATON.

coinage, silver "blanks" to the nominal value of £1,000,000 sterling! The completion of this large order in the short space of six months attests in itself the exceptional resources of their gigantic establishment.

An examination of samples of the gold, silver, nickel, and bronze coins produced at the Birmingham Mint is no less interesting than instructive. It shows, in the first instance, the wonderful perfection to which the art of Coining, as here carried on, has been brought, and gives one also a curious insight into the great variety of emblems and inscriptions adopted by different nations. More than this, however, such an examination affords historical data as to the dynastic changes which have periodically taken place in different countries; as, for instance, in France and Italy. Apropos of the latter country, it is worth recording that Messrs. Heaton supplied the Italian Government some years ago with 21,000,000 worth of lire in pieces of 10, 5, 2, and 1 centimes. During the last few years, again, very heavy contracts have been carried out for various foreign Governments. As recently as 1884, seventy-five tons of nickel money were supplied to Servia; a further quantity to Jamaica; and an entirely new coinage in silver and nickel to the Republic of Ecuador. Only

within the present year Egypt and Columbia have similarly received new nickel coins; while, at the time of writing, various other important contracts are in process of execution. It will, however, save further particularising, if we state that altogether some forty different States and Administrations have received their supply of metallic money from the Mint in Icknield Street. It thus appears, that while a century ago Birmingham was regarded as "the toyshop of Europe," the town may now, thanks to the unaided efforts of Messrs. Heaton & Sons, claim to be, in a sense, the Treasury of the World; for here, as we have pointed out, definite shape and form are given to what Shakspeare has wittily termed the "visible god that speaks with every tongue to every purpose."

The process of coining itself is one of exceptional nicety, and requires in its various operations a degree of exactitude, an attention to detail, and an accuracy of observation, such as are probably not equalled in any other branch of manufacture. At the Works under notice, the whole of the processes are carried on; and the most improved plant and machinery—much of it the invention of Messrs. Heaton themselves—are available to insure that high degree of finish which distinguishes all the Coinage of this particular Mint. The motive power is supplied by steam-engines of, in the aggregate, about 500-horse power; and these, as well as the various steam tools and other appliances, are so arranged that time and hand-labour shall be as greatly economised as possible; and how effectively this is done will be apparent from the fact that from the time the rough ingot or bar of



MACHINERY FOR MAKING SEAMLESS COPPER TUBES.

precious or other metal is received into the store, until it is issued in the form of finished coin, it never traverses twice the same ground.

After the metal has been assayed and brought to the proper standard, it is cast in the shape of bars. These are passed on to the rolling-mills; the rolls being gradually brought nearer and nearer to each other, the ingot is, by degrees, reduced in thickness, and lengthened out in the form of a ribbon, and it can thus, if desired, be made as thin as a sheet of paper. The rolling tends to make the metal too brittle for the subsequent operations, and it has, therefore, to be repeatedly annealed. The next process is the stamping-out, where, by the aid of presses, the circular discs, or, as they are technically known, "blanks," are cut out of these fillets. The precision of workmanship is illustrated in this process, for we believe that no two "blanks" differ from each other in diameter by even the most infinitesimal fraction.

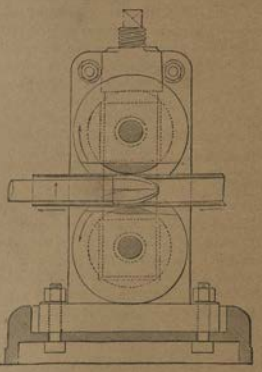
Some minor processes having been gone through, which differ according as to whether the metal employed be gold, silver, or bronze, the next operation is the coining proper. For this purpose lever presses are used. In each of these is inserted a steel die and counter-die to impress, respectively, the two sides of each coin. The counter-die is at the bottom, face upwards, and on it the "blanks" are placed automatically. An encircling collar then rises and encloses the coin; the upper die next descends with a pressure of about forty tons, and impresses at one blow the two faces of the coin, while by the same operation the crenated collar surrounding the coin produces the milled edge, which is so important a protection against the formerly prevalent practice of clipping. For all practical purposes the coin is now complete, although gold

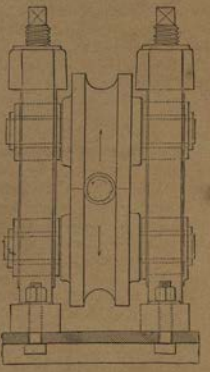
and silver money has, before it is sent out, to be weighed by a most delicately-adjusted balance. The above is but a brief outline of the process of Coining, which must be seen in operation in order to enable one to appreciate its many intricate and delicate operations.

Messrs. Heaton & Sons' establishment is the largest private Mint in existence throughout the world, and the precious metals which are annually transformed here from unsightly ingots into current coin, represent a truly fabulous value. As a matter of course, the utmost precautions are taken to insure that not a grain of gold, &c., shall be lost or stolen, and the greatest vigilance is exercised throughout. That portion of the Mint where the precious metals are handled is surrounded by glass screens, so that every process can be watched.

Independent of the branch of business just described, Messrs. Heaton & Sons are also extensively engaged in the manufacture of copper and brass tubing of every description, which, as is well known, is largely used in most branches of the brassfoundry industries. They also produce on a very extensive scale blanks for cartridges, caps, &c., for both the British and foreign Governments; gaseliers and gasfittings, copper and brass wire for all purposes, plumbers' fittings, stamped and cast ornaments for lamps, bedsteads, ceiling roses, and knobs, medals, and a long list of other manufactures of a cognate description.

From amongst these numerous branches of manufacture, we must single out for fuller description that of





solid drawn copper tubes by an entirely new and patented process, invented by Mr. James Robertson, of Glasgow. A revolving mandrel is forced by hydraulic pressure into a copper billet, fixed co-axially with it. Cast round billets of 4, 5, 6, and 7 in. in diameter, and about 2 ft. 4 in. in length are employed, and although not essential, it is found most economical first to pierce a hole 1¼ in. in diameter the entire length of the billet. On passing a 3-in. mandrel through the billet in this form, it is elongated to a length of about 4 ft., when it is known as a "shell," and passes to the drawbench. The primary object of the initial hole is to allow of the mandrel being lubricated. This is done with oil so effectively that the mandrel never gets over-heated, and the shell can be handled immediately after the operation. The necessary end-pressure of from 40 to 150 tons is given by a ram, and the water within the hydraulic cylinder is at the same time used as a back centre, thus avoiding excessive waste of power from friction. The ram carrying the mandrel attached to its front face by a clutched-plate is caused to revolve by gearing, the driven spur-wheel being also fixed to the front end of the ram.

The copper billet is held in a pair of half-round dies, while end-traverse is prevented by steel holding-dogs fitted in the front end of these dies. The mandrel is enlarged at its extremity, in a bulbous form, having a sharp point, and three cam-shaped inclined working edges on its surface. Each inclined edge as it revolves

spirally causes a wave of metal to roll before it, and thus widens out the hole and elongates the billet, the direction of rotation being, of course, the converse of that adopted in drilling. The mandrel revolves at a rate of about twenty revolutions per minute in making a hole 3 in. in diameter, and the traverse end-wise is from 6 to 10 in. in the same interval, according to the temper or "pitch" of the copper operated upon.

This process, which is equally applicable for making tin, brass, and other alloys of copper into tubes, marks a wonderful advance upon all methods of tube-drawing hitherto in use, and its exceptional value is widely appreciated by users of metal tubing who require something stronger and more solid than that generally available.

It is hardly necessary for us to say a word as to the quality and workmanship of the various productions of "The Mint." The facts that the Coins here made are in use in almost every part of both hemispheres, and that the reputation of Messrs. Heaton's other manufactures just referred to has secured for them an unassailable reputation alike in the Old and the New World, may be left to point their own moral. Suffice it to say here, that the Firm can produce credentials from a long array of Potentates and Ministers of State, expressing in most flattering terms their high approval of the creditable and artistic manner in which the various Coinages have been carried out. Nor have the important services thus rendered failed of recognition of a more flattering and personal nature, and a few years ago King Victor Emmanuel conferred the honour of a Knighthood upon Mr. Ralph Heaton, and a similar distinction was subsequently bestowed upon Mr. George Heaton, who was then a member of the Firm. Other honours have also fallen to their share, and we reproduce herewith some of the foreign Decorations by which Messrs. Heaton's various and successful efforts to improve the Coinage of different nations have been acknowledged by reigning sovereigns. Prize medals have also fallen to the share of the Firm repeatedly, and for them it may be claimed as literally true, that their productions are in the hands or pockets of millions upon millions of people among well-nigh all the races of mankind. Messrs. Heaton also supply the various expensive tools and appliances required for Coining, to different Government Mints, many of which have been completely fitted up by them; and some of the latest and best patent presses (distinguished by their noiseless and automatic working) which are in operation in our own Royal Mint, on Tower Hill, are the work of this Firm.

One of the greatest of modern historians has well observed that it is open to question "whether all the misery which has been inflicted on the English nation in a quarter of a century by bad Kings, bad Ministers, bad Parliaments, and bad Judges, was equal to the misery caused in a single year by bad crowns and bad shillings." Regarded in this light, it will be acknowledged that our own no less than other nations are indebted to Messrs. Heaton & Sons for the many and important reforms which they have effected in the system of Coinage. The success and growth of their business have been attained simply and solely by the energy intelligence, constancy of purpose, and painstaking personal attention of the present head, Mr. Ralph Heaton.

[We are indebted to the Editor of *Engineering* for the plans having reference to the manufacture of Seamless Copper Tubes, the same having appeared in his journal of 17th September, 1886.]

Messrs. George Clark & Sons, Hull.

INNUMERABLE as are the uses of Copper in connexion with the Industrial Arts, it is a curious fact that this particular metal has enjoyed a high reputation from almost the earliest ages of the world. In many Scandinavian tumuli of very remote periods, which have been opened in Denmark, there have been found pre-historic tools and knives formed principally of copper, and the profuse application of copper and gold in some of the implements when contrasted with the parsimony evident in the use of iron, seems to prove that at the unknown period, and among the unknown people who raised these tumuli, gold as well as copper was much more abundant than iron. It has also been ascertained that in classical times copper was employed for many of the purposes for which iron has been used more recently; and arms no less than tools for husbandry and the mechanical arts were, both in the times of the Greeks and Romans, made of copper. Reference to this metal also occurs in Scripture history, where allusion is made to "vessels of fine copper precious as gold," thus seeming to imply that in the days of Cyrus, King of Persia, copper was held in high esteem. Again in the New Testament among the few handicraftsmen mentioned by name is "Alexander the coppersmith," a reference which may be taken to plainly indicate that even 1,800 years ago the manipulation of copper formed a leading industry.

Even as then so now, Copper-working is a most important branch of manufacture, and it would be difficult to exhaust the list of trades which are not to a greater or less extent dependent upon the art of the copper-smith and brazier for the utensils and other means with which to carry on their trades. The various processes connected with the manipulation of copper have, however, undergone great changes since the time of "Alexander the coppersmith," and no better insight into the manner in which the business is now carried on could probably be gained than is afforded in the establishment of Messrs. George Clark & Sons, of Waterhouse Lane, Hull, which in commemoration of the before-named early pioneer of the craft is named the "Alexander Copper and Brass Works." The extent of the business done is so considerable, the variety of operations carried on so manifold, and the articles produced are so multifarious, that we can, in the present article, touch only upon some of the most salient features, since to do justice under each of these heads would require far more space than is at our disposal.

The Works, which have developed from small beginnings, have now assumed large proportions, repeated extensions having been made, and even at the time of writing considerable additions are being made, an adjoining block of buildings having been secured which is now being incorporated with the Works. As a general clue to the business carried on we may say that the Firm manufacture everything in copper that is used in connexion with marine or locomotive engine work; brewery, distillery, oil-mill, and varnish making plant; while they also produce all classes of copper and brass ship-fittings, the mere enumeration of which latter articles would fill some pages of this ALBUM. It says much for the Firm's reputation that they have

for years past made all such ship-fittings in copper and brass for many of the largest shipbuilding concerns in this country. A considerable number of war vessels have also been fitted by them; while they, moreover, supply the various accessories of this description for torpedo boats, and many other purposes.

Leaving generalisation, we will give a brief description of some of the more important departments of the "Alexander Works." Of storerooms for raw material there are quite a number. The first one we enter is filled with sheet copper of all sizes for pipes, &c., of every description. In the next one we find a large assortment of copper tubes, tons of which are kept in stock. Another storeroom, known among the employés as the "Gold Mine," is filled with tons upon tons of ingots of tin, copper, brass, and spelter, the prime cost of which represents many thousands of pounds, and this amply justifies the name given to the room.

Coming to the workshops proper, the first in order is the coppersmith's shop, where we noticed in course of construction large pipes up to thirty inches in diameter, intended for a war vessel. These are all hammered out of sheet copper. The most improved appliances are available here, as everywhere throughout the Works, to expedite operations. We noticed especially four powerful steam hammers for planishing; they work at a speed which it is impossible for the eye to follow, giving as many as 500 blows a minute. Among the more important articles in course of construction at the time of our visit were brewing pans and special plant for varnish manufacturers; copper surface condensers and pipes for torpedo cruisers, &c. The riveting of all such work is done by hand, the essential conditions of solidity and substantial workmanship being always kept in view. There are a number of other shops in which operations of a cognate nature, though somewhat varying in detail, are carried on. Hardly a single article of coppersmith's or brazier's work suggests itself but is to be seen in course of construction in one or other of the many workshops that form the busy hive of industry under notice. Here is also at work an ingeniously contrived "steam arm" for planishing copper, and there are in addition drilling, screwing, punching, shearing, and other machines. Near by are the brazing shops, the fires in which are worked by fan blasts actuated by steam. This brings us to speak of the motive power of the Works, which is supplied by a large boiler and a powerful engine.

In another department we find three large hydraulic presses for bending copper pipes and coils, &c., and several testing machines, in one of which, on the occasion of our visit, a steam separator was being tested by the aid of hydraulic power to twice its working pressure. The same plan is followed with pipes and other such appliances. By bringing into requisition all such precautionary measures the Firm are able to guarantee the quality and wearing capability of every article they produce; and it is no mean tribute to their reputation to be able to aver that none of their steam, or other plant, has ever been known to fail or break down.

Brass-founding is carried on on a large scale, and no effort is wanting to insure the best quality of metal and perfect workmanship. The several melting furnaces are all of large size. In addition to brass, gun metal, bronze, zinc, and all kinds of patent metals are used for castings; and in this branch the Firm have many special and well tried recipes of their own. Some of the castings made are very large, weighing over two tons. The brass finishing shops are replete with all kinds of steam tools, including planing, shaping, milling, slotting, boring, and various other machines. Turning-lathes of the most improved patterns are also provided, including double-headed ones for cock-making, and several others of exceptionally large size.

Yet another department is set apart as a tinsmith's shop; but to refer to each of the many other work-shops would prove but wearisome. Suffice it to say that the establishment under notice is thoroughly self-contained and replete in all its resources. Every process connected with the manipulation of copper or brass is carried on, and the work done comprises the whole range, from the largest down to the smallest article.

Before passing on, however, reference must be made to the Steam Gauge and Nautical Instrument shop—a branch to which Messrs. Clark & Sons devote great attention, and in which they produce work of the highest merit. In this department—located quite apart from the other portion of the Works—are made and repaired all kinds of gauges, such as steam, vacuum, and hydraulic. There is no need to dwell upon the fact that the utmost exactitude is essential in the adjustment of these, and this is fully attained, as the Firm guarantee all gauges supplied by them to correctly indicate the exact pressure brought to bear, from 1 lb. up to 15,000 lb. per square inch. The contrivances for testing here provided are of a special and most delicate nature, and fill the spectator with admiration at the ingenuity and skill that have been exercised in making what would at first glance appear to be a most complicated and difficult operation one of exceeding simplicity, and as trustworthy in its results as it is possible for the work of man to be.

We are next ushered into one of many storerooms for finished goods attached to the Works, and even the most cursory survey impresses one with the truly marvellous diversity of the articles here stowed away in drawers, on shelves, and in pigeon-holes. Indeed from floor to ceiling not an inch of space is wasted; turn whichever way we may we are confronted by what may be truly described as an endless array of brass and copper fittings. A glance round this room does more than any amount of theoretical instruction to impress upon the mind how many thousand metal accessories are required for a properly appointed sea-going vessel. Here we have a truly bewildering array of brass side scuttles, deck lights, stanchions, pump fittings, hydrants, steam-pressure gauges, engine counters, coal scoops, stew and preserving pans, kettles forged copper and yellow metal nuts and bolts, tap wrenches, ratchet braces, wrought copper and iron boat nails and roves, and copper braziery work of all descriptions. The articles coming under the head of brewers' plant are almost as varied, and include refrigerators, thermometers, saccharometers, steam worm coils, and attemperators, &c.

MR. GEORGE CLARK, SEN.

Similarly there is a long list of appliances specially adapted for distilleries, oil mills, dyeing works, tallow manufacturers, sugar boilers, &c. Of gauges we notice specially a large assortment of those of E. Bourdon's Paris own make, being agents for this eminent firm. Next we light upon ventilators, ships' lamps, deck lights, lenses, Cocks and valves, condenser tubes, injectors, and Hancock's patent inspirators and steam lifters (for which special classes of goods the Firm are sole agents). India-rubber goods of all kinds and thicknesses are here, such as sheet and cloth insertions, packings, valves, &c. But it would be tedious to go on enumerating further, since the list of manufactured articles in stock is almost inexhaustible. In addition to these the Firm do a large trade in ingot and sheet copper, bolts and bars, yellow metal sheathing, condenser plates, block tin, spelter, sheet brass and steel, copper, brass, and iron wire in all thicknesses, down to the finest gauze wire. In tubes again there is on view every kind used for gas, steam, water, hydraulic and other purposes, and some of these are made in sizes up to thirty inches diameter. Here it will not be out of place to mention that Messrs. Clark & Sons are agents for J. Bibby, Sons & Co., the well-known copper smelters.

Other departments there are to which we cannot refer in detail, such as the pattern shop filled with

thousands of valuable patterns; the department in which the metal filings and oddments, which represent a considerable value, are separated from the shop-sweepings to be again utilised; and a number of other storerooms. As regards the last, we need but say that the stock of manufactured articles is sufficiently replete and varied to allow of any ship's outfit in copper, brass, and other metal work, to be completed at a very short notice. This brings us to speak of the many and important contracts of this description which are constantly falling to the Firm's share. Not only do Messrs. Clark & Sons manufacture a quantity of copper and brass in connexion with the shipbuilding yards at Hull, but they carry out similar contracts for vessels built or repaired in many of the largest establishments of the Northern and other parts of the kingdom. The very fact that the work has been executed by them is regarded as a guarantee of workmanship and quality, and marine and other surveyors, under whose critical observation such work is constantly brought, know well how to appreciate its standard merits.

A worthy place in the Peerage of Commerce of which this volume is a record belongs to the man who some thirty years ago laid the foundation of the business we have just briefly described, and by whose hard work, patient application, and indomitable perseverance, it has been developed to its present position of being the largest Coppersmith's and Brazier's Works in the North of England, and one of the largest in the United Kingdom; one moreover which for the quality of its productions stands unexcelled. Mr. George Clark, whose portrait appears on the previous page, originally started in a small way; his own pair of hands constituting so to speak his whole working staff. But by dint of energy, and above all by making it his conscientious study to produce nothing—however insignificant the article—but what should be best of its kind, in shape, workmanship, and finish, he soon established a name, the reputation of which was not confined to his own locality. Work was pressed upon him, and his counsel and guidance were everywhere *in* demand. The Firm of which he is the head still enjoys his active co-operation and advice, and the value of these cannot be over-estimated when it is borne in mind that he has behind him a record—probably unparalleled in the modern annals of industry—of fifty-eight years' hard work and experience! And yet as our portrait shows he looks but in his prime, and both his mental faculties and physical strength remain unimpaired, and seem to belie his age of sixty-seven years. The practical management of the business now falls to the share of his two sons, Mr. Charles Clark, and Mr. George Clark, jun., both practical men of great aptitude, and worthy sons of a worthy sire. It needs no prophet to predict that under their energetic administration the Firm will continue to prosper and to uphold its unrivalled prestige, while its future seems further insured by the fact that already a third generation of the family, is, like the present partners, receiving a practical training in the workshops of the Firm.

Messrs. Brown & Polson, Paisley and London.

THERE is no plant or vegetable cultivated by man that is capable of being applied to so many purposes of utility as Indian Corn or Maize. A slight glance at its many and diversified uses is sufficient to show how extensively and intimately it is interwoven with the interests of the human family. The grain, both green and ripe, the stalks and leaves in the successive stages of their growth and maturity, the husks that envelop the ear, and the cob that supports the grain,—all are adapted to economical purposes, and fitted in a variety of ways to subserve the wants of man. In the unripe state it is greatly esteemed in the United States as a vegetable; the cores of the cobs are employed as fuel; and from the juice of the stalk sugar and syrup have been obtained. The husks, again, are put to many domestic uses; slit into shreds, they are employed for stuffing mattresses, and the more delicate inner ones are selected and plaited into table-mats and even bonnets, while the coarser ones are utilised for making door-mats, &c.

Exceptionally nutritious as Maize or Indian Corn is, it was comparatively little known and used in this country until about the middle of the present century, when a British Army Surgeon, Dr. J. S. Bartlett, addressed a letter on the subject to Lord Ashburton, in the course of which he urged that "Maize possesses great superiority over rye, barley, oatmeal, or potatoes, and consequently makes a better article of food." William Cobbett also recognised its economical value and nourishing qualities, and it was said of him that he wrote about Indian Corn, planted Indian Corn, raised Indian Corn, ate Indian Corn, made paper from Indian Corn husks, and printed a book on Indian Corn paper. All these efforts failed, however, of the desired success. Something more was needed to prepare from the Maize a food suitable for this country, and it was to the solution of this problem that Mr. John Polson more than thirty years ago devoted his attention, and with what result is shown by the world-wide celebrity attained by Messrs. Brown & Polson, and the universal favour in which their Corn Flour is held, not only in this country, but also in many parts of the Continent, as well as in India, &c.

When Mr. Polson took up the problem to which we have above referred, he wisely recognised that Maize in its natural state is more difficult of digestion than many other grains, and he therefore set himself to work to discover a means of overcoming this drawback. As is well known, an article of food may be highly nutritious, and yet exceedingly indigestible, and such was the case in this instance. His observations enabled him to prove that it was the oily or fatty matter contained in Maize which disagreed with many persons, and he accordingly, as the result of protracted experiments, invented a process for extracting such oily components and other unsuitable constituents from the grain, leaving only the pure starch.

Starch, as all dietetic authorities agree, is the most important of heat-givers or force-producers in human food. Such starch is present in potatoes, bran, wheat, peas, haricot beans, Scotch oatmeal, rice, pearl barley,

and other vegetable products. It may be worth while to emphasise this point by a few figures. According to Professor Church, one of the greatest living authorities upon the subject, potatoes contain 15 per cent. of starch; haricot beans, 49 per cent.; Scotch oatmeal, 63 per cent.; wheat and rye, 71 per cent.; while Corn Flour is practically a pure starch. Starch, and consequently Corn Flour, contains carbon, hydrogen, and oxygen, all of them essential elements to human life; no wonder, therefore, that the eminent writer just quoted describes it as "next to oil and fat, the most concentrated, heat-giving, and force-producing of all the nutrients."

It will thus be seen how great a service Mr. Polson rendered to the community when he thus produced from the hitherto unpalatable Maize a food at once nourishing and toothsome. It is a well-known fact that Englishmen generally adopt a diet suited for a somewhat more northerly latitude than that which they occupy; and, as a rule, they consume too much animal food. As has been pointed out by Sir Henry Thompson, it is a common failing to take too large a proportion of fatty constituents in our food, and his lengthened experience has convinced him that "nitrogenous matter also is commonly supplied beyond the eater's wants," and is "a prolific cause of disease, such as gout, rheumatism, and their allies, as well as affections of a serious character, which would in all probability exist to a very small extent were it not the habit of those who, being able to obtain the strong or butcher's meats, eat them daily, year after year, in larger quantity than the constitution can assimilate." It is this question of supplying an assimilative food which is so effectively solved by Messrs. Brown & Polson's Corn Flour. Starch, as we have before mentioned, forms the greatest proportion of the elementary substances necessary to build up the human body, and it is, consequently, a most important alimentary constituent. While it thus amply meets the principal wants of the constitution, Corn Flour is, by reason of the delicacy of its structure, easily converted into gelatinous and readily-assimilable food. Indeed, the digestion of Corn Flour may be said to commence in its preparation by cooking; and, being so easily digested, it is specially adapted for the use of children, invalids, and all persons whose digestive organs are weak, and to this latter class belong probably the larger proportion of our countrymen outside the working population.

It has been objected by the unthinking, that the gluten being entirely extracted from Corn Flour, the latter is deficient in nutriment. Such objections, it has been pertinently observed, are somewhat similar to the objections made years ago to the extraction of quinine from bark, or morphia from opium. The answer to this contention is that it is of the utmost importance that both children and invalids should be dieted with assimilable food suited to their different constitutions, since its proper and speedy digestion is of far greater consequence than the loading of the stomach with food composed of all the elements, but which the alimentary organs are too weak to assimilate. Moreover, its deficiencies in gluten, &c., are fully supplied when used with milk, and it is intended by the manufacturers to be thus used, and, as a matter of fact, in nearly every household milk is regarded as the almost indispensable adjunct. Indeed, the action is reciprocal; for it is well known that pure milk itself disagrees with many persons, but when cooked with Corn Flour, say in the form of a soup or gruel, it is rendered easy of digestion, as the very boiling facilitates this by rendering it gelatinous.

It will not be out of place to say a word or two as to the culinary applications of Messrs. Brown & Polson's specialty. It forms a very pleasant dish when made into puddings, blanc-mange, and jellies, and is a most relishing food for children and invalids. It is also valuable for making biscuits, cakes, porridge, for thickening soups and sauces, and for a variety of similar purposes familiar to every *chef de cuisine* and housewife. It should, in fact, be in common use at every table, for it forms a welcome addition to any meal. Nor is its adaptability limited by climate. There is no country of the world where it is not known, and so free is it from liability to fermentation or other mischief that it may be kept with safety for years where other foods would quickly spoil.

That Corn Flour possesses all the qualities to which we have above referred, has been attested again and again by some of the leading men of the medical profession and by scientific authorities, but to set out their names is beyond the scope of this article. Not only have they borne testimony to its uniform excellence as a heat-giving and force-producing food, but, what is more, they have recommended and prescribed it in their own practice. If, as it is said, imitation is the sincerest flattery, then abundant tribute to the merits of the Firm's Corn Flour has been borne by the numerous competitors with which it has had to contend. Although Messrs. Brown & Polson not only were the first to make the article in question in this country, but also gave it its present distinctive name, Corn Flour, a whole host of imitators sprang into being in the course of a few years, and appropriated the name and applied it to inferior articles, sometimes consisting simply of rice, or of some other commonplace and cheap substitute. The chief characteristics of the Corn Flour of the original makers have been its uniform purity, excellence, and superior quality.

Having regard to its now world-wide reputation, and to its acknowledged value as a strength-giving and force-producing aliment, it seems strange to recall the fact that some thirteen years ago a wiseacre of the time almost created a panic in the country by his denunciation of this nutritious delicacy before a Committee of the House of Commons. The erroneous character of his statements was, however, soon exposed by a long array of medical men, some of whom (in order to demonstrate how altogether devoid of foundation were the allegations made) offered to bring their children before the members of the Committee, as living testimonies of how well they had thriven on a diet consisting mainly of Corn Flour. The sequel to this story remains to be told. Within less than a twelvemonth, the witness above referred to, who had waxed so eloquent in his denunciation of Corn Flour, addressed a letter to Messrs. Brown & Polson with the object of, to use his own words "giving spontaneous expression of my views"; and what those views were will appear from the following excerpt from the letter. "I am quite convinced," says the writer, "that your claim as to Corn Flour possessing all the properties of the finest arrowroot, and serving all its purposes, is accurate and well warranted; and it affords me some pleasure to be able to add my unsolicited testimony to this effect." However reprehensible the witness's conduct may have been in uttering his wholesale and unqualified denunciation, one must acknowledge the letter from which we have quoted to have made the *amende honorable*.

Since then, however, many other medical specialists have contributed their testimony, and have endeavoured to impress upon the public that Corn Flour "forms an important article of diet, which resembles dietetically and chemically an arrowroot." There is quite an accumulation of unimpeachable evidence of this nature, and the popular testimony of the millions of consumers has for some thirty years past endorsed the conclusions arrived at by scientific experts. It is not going beyond the literal truth when we aver that, of all prepared foods, Corn Flour prepared with milk is one of the most palatable, digestible, and most widely useful. Heat-generation is, according to Dr. Smith, the most urgent function required in connexion with the sustenance of the body, for, says he, "whereas the body may waste for a lengthened period and yet live, it rapidly dies when the source of heat is removed, or even greatly lessened." Corn Flour, consisting, as we have endeavoured to point out, almost exclusively of purified edible starch, and the latter being the most potent of heat-givers and force-producers, it follows that the food under notice stands unrivalled for its dietetic virtues.

Apropos of this mention of starch, it is worth recurring to what has sometimes been urged by hypercritical persons, and more especially by the interested makers of inferior substitutes, viz., that "Corn Flour is only starch." This is a fact which Messrs. Brown & Polson have themselves set forth and have emphasised from the early days of the manufacture, "with the assured conviction that this constitutes not only its true title, but its just claim to a large and beneficial consumption." Corn Flour or other food of similar character is an element absolutely necessary to every individual in greater or less proportion, according to the variations of the general diet; whilst to children who have passed beyond the early stages of infancy, and to invalids and persons of

weak digestion, it is yet more essential. Serving the same digestive and calorific purposes as animal fat, it can be taken with impunity when fat would be offensive to the palate or disturbing to the system, and, unlike fat, it is free from the fatal tendency to obesity. When prepared with milk, it forms a really substantial diet: at once nitrogenous and carbonaceous, tissue-forming and heat-giving, and thus meets every requirement of the human frame. In India, again, Corn Flour possesses a dietetic value which cannot be over-estimated. Cow's milk sours there so rapidly as to be inimical to the health of children, who are, therefore, very largely fed on Corn Flour mixed with water, with chicken broth either mixed with it or added as an alternative diet, and on this, as is well known, they thrive greatly.

Before bringing this notice to a close, it will be worth while to give a brief history of the invention of the article of food we have been discussing. More than thirty years ago, Mr. John Polson,—who, we are pleased to be able to record, still continues to preside over the business,—invented the manufacture of starch from Maize, and secured the invention by patent rights. After the business had been started, and the process had been in active operation for some time, it was discovered that, shortly before, something similar had been attempted in America, but it was not till many years afterwards that the Firm ascertained what the American process was like. Subsequently, Messrs. Brown & Polson introduced an edible preparation of their Corn Starch as a food, and gave it the more euphonious title of "Corn Flour,"—a name that has since become familiar as a household word. As further showing the independent nature of the invention, it is worth mentioning that the American makers have since then adopted one part after another of Mr. Polson's process. Indeed, a lawsuit as to the alleged infringement of an American patent relative to the manufacture of Corn Starch, has been for some time pending in the United States, and the defence is that the alleged patent is void, as having been anticipated by Mr. Polson's process of the year 1854. We believe that a Commission has come over to this country to take Mr. Polson's evidence on the subject. No stronger testimony is needed to establish the originality of Mr. Polson's invention. Moreover, by Messrs. Brown & Polson's method of manufacture, all the waste substances of the Maize are utilised as food for cattle,—an economical factor in production which is not practised in the United States. Thus, then, we have traced the history of an important branch of National Industry. The extensive factory of the Firm, known as the Royal Starch Works, where the Corn Flour is made, are situated at Paisley, Scotland, while the commodious London warehouse and offices occupy an imposing block of buildings in Queen Victoria Street.

It will be seen from the foregoing, that Messrs. Brown & Polson have been true benefactors to their race in having added materially to their food supply, and that in a direction in which our own natural resources fall most short. Not only so, but, as Sir Henry Thompson has pointed out, mankind is "prone to choose foods which are too rich in nitrogenous or flesh-forming material," and too small account is taken generally of the different requirements by the child, the mature-adult, and the declining or aged person. This difficulty, as we have shown, has been overcome in Corn Flour; for, prepared with milk, it stands unequalled for its value as a material to build up and sustain the composite structure of the human body. It is alike adapted to the physical needs of the body, and to the healthy action of the mind, and thus conduces to ensure *mens sana in corpore sano*. Abernethy's quaint maxim, that Diet cures more than the lancet, has received over and over again striking illustration by the experience of the users of Brown & Polson's Corn Flour.

It remains but to add that the firm are Manufacturers and Purveyors to Her Majesty the Queen, and that they have been awarded Prize Medals at many Exhibitions. On the Continent, too, the product is in very great favour; it being there known as "Mondamin," under which name the grain has been immortalised by Longfellow, in his "Song of Hiawatha." Another poet has equally sung the beauties of a Maize field in the following tuneful lines, with which we may appropriately close this article:—

> The fruitful Maize, in verdant vistas rear'd
> Its spire majestic to the playful breeze
> Spreading its loosely-waving panicles, while low
> The purple anthers bending over to kiss
> The silken tassell'd styles, delight the eye
> Of watchful Ceres.

Messrs. Joseph Rodgers & Sons, Limited, Sheffield.

DURING the last fifty years many wondrous revolutions have been wrought by Science in connexion with the Manufacturing Industries of this country. There is probably not a branch of art or manufacture but is due to, or has been materially benefited by, scientific discovery. Science and Trade are, indeed, interdependent, and without their mutual co-operation our manufacturing greatness could never have been attained; for it is the aid of Science and its manifold applications which have enabled us to utilise our abundant stores of coal and iron ore, and turn them to account in a variety of mechanical, physical, and chemical processes. This truth is strikingly illustrated in connexion with the trades of Sheffield. Herself of high antiquity, this town has from an early period been celebrated for her manufactures. In days when archery was the method of warfare, it was here that the iron heads of arrows were largely manufactured, and Chaucer, the father of English poetry, mentions that one of the Canterbury Pilgrims, the Miller of Trumpington, wore a Sheffield knife,—a singular illustration this, that five centuries ago, even as to-day, the art for which Sheffield was renowned was the production of knives. Her citizens may well be proud of the fact that no other town in the United Kingdom,—nay, no other country in the world,—has ever rivalled Sheffield in the excellence of its first product and its last—the manufacture of Cutlery.

While thus able to trace back her staple industry to days when the total population of this country was no larger than is that of London at the present time,—to days when Printing had not yet been invented, when—

> Man knew no means to hold the flitting race
> Of Art's coy forms, that courted his embrace,
> His only hope in memory's stinted power,
> The oral record—changing every hour;

it is, nevertheless, a fact that for more than three centuries but little progress was made in the manufacture of Cutlery. It was a period during which even the most skilful artisans groped their way in the dark, the importance of Science being wedded to Industry not having as yet been recognised. With the approach of the eighteenth century, however, a fresh stimulus was given to the trade. About this period the inhabitants began to display their ingenuity and ability in making considerable improvements in their manufactures, and thus helped to build up what is to-day one of our great branches of national industry. From among those who were mainly instrumental in bringing about this salutary result stands out the Firm of Joseph Rodgers & Sons, Limited, whose business was established about two centuries ago, and who may, therefore, be rightly ranked among the Pioneers of the Cutlery Trade.

The earliest existing record of the business shows that, in the year 1730, Messrs. Maurice & Joseph Rodgers, who then constituted the Firm, removed from Hollis Croft to Sycamore Street, and with the increase of the business constant additions were made to the premises, until the Firm's buildings now form a

huge block, extending from Norfolk Street to Sycamore Street, and from Flat Street to Milk Street. It will thus be seen that for a period of well-nigh one hundred and sixty years the business has been carried on in the same locality—a circumstance which has probably but few parallels in commercial history. Large as is the factory figured below, it does not by any means represent the whole of the Works, for the Firm have branch establishments in adjoining thoroughfares, where distinct processes are carried on. It will give some idea of the extent of the business done when we mention that nearly 2,000 persons find employment here, and that the weekly output of manufactured goods is equal to 60,000 table-knives and forks, 3,000 carving-knives and forks, 18,000 spring-knives, some 15,000 razors, and an equal number of scissors! These astounding figures, which represent an annual production of millions, may well prompt one to ask, Where all these articles

NORFOLK STREET WORKS.

of Cutlery can possibly find a sale? This question is, however, answered by the simple fact that Messrs. Rodgers & Sons' specialties in Cutlery find a market in every quarter of the habitable globe. Their trade-mark, as here shown, is everywhere recognised as a guarantee of high quality and sterling worth. In the shops on the Paris boulevards, no less than in the bazaars of the East, Cutlery impressed as above, with a Star and Maltese Cross, together with the name of the Firm, is in special demand, and is deservedly held in as high estimation as were erewhile the blades of Toledo and Damascus.

V. R.

JOSEPH RODGERS AND SONS,

CUTLERS TO HER MAJESTY.

World-wide as is their reputation, Messrs. Rodgers have not attained to their present pre-eminence by any adventitious means. At their Works a scientific knowledge regulates the whole of the manufacturing processes, while none but the best materials are employed, the utmost pains being, moreover, taken to insure the most

skilful workmanship and finish. For table Cutlery the best shear steel is used, prepared from the finest Swedish bar-iron; and for razors and spring-knife Cutlery the best refined crucible cast steel is employed. It is a distinguishing characteristic of this Firm that the steel used is uniformly of the best quality, and in this respect there is no distinction between the moderately-priced article and the most expensive one, the difference in price being accounted for by the more costly nature of the materials used for handles, the more elaborate enrichment and the superior finish which characterise the higher-priced article.

Having regard to the intricate nature of the manufacturing operations, and to the fact that an ordinary three-bladed pocket-knife passes through more than one hundred distinct processes before it reaches the hands of the purchaser, we cannot, within the limits of this article, give a description of the various stages of

ENTRANCE TO SHOW-ROOM.

FIRST SHOW-ROOM.

manipulation. Indeed, success depends so largely upon the technical proficiency of the workman, upon his deftness of finger, his knowledge, experience, and skill, that a mere verbal explanation of the various *modi operandi* would fail to give the reader an adequate idea of the difficulties of the work. Suffice it to say that, from the moment when the bar of steel is drawn from the furnace, to the time when the knife or razor receives its final polish, Science, guided by the highest order of craftsmanship, presides over the almost countless changes of form, quality, and temper which that bar undergoes. The raw material is, of course, of the utmost importance in connexion with the manufacture of Cutlery, and, to insure a uniform standard of excellence, all the steel used is made at the Firm's Works; while the quality of the workmanship is guaranteed by the fact that none but the most expert artisans are employed—men who are perfect masters of the trade.

Equally great pains are taken to insure the artistic excellence of the articles, and suitable ornamentation of a more or less elaborate character is applied to the handles, while the blades themselves are enriched with

etchings or other methods of ornamentation. Great scope for delicate embellishment is afforded by the handles or hafts of the various knives. Among the materials used for this purpose are pearl, ivory, tortoiseshell, stag, buck, buffalo, and other horns, foreign woods, xylonite, ebonite, &c. The last-named material was introduced for the purpose by Messrs. Rodgers themselves. While of lighter weight than other substances used for handles, ebonite has the additional advantage of always retaining its brilliant polish and jet-like appearance. The various materials above specified are all bought by the Firm first hand and in large quantities; care being taken that all are selected and the best of their kind. In this department, as elsewhere throughout the whole of the Works, the most improved machinery and appliances are brought into requisition. But these are, after all, a minor consideration, for, in the manufacture of Cutlery, the perfection of workmanship is only attainable by the aid of the hand, the only instrument which is capable of executing whatever man's ingenuity suggests. The beating out of the blades, the hardening or tempering of the steel, the "handling" of the knives by the grinders, and the fitting together of the various parts, all require much patient care and thought, and necessitate on the part of the operatives a well-trained judgment and exceptional dexterity of manipulation.

SECOND SHOW-ROOM.

Interesting as are the manufacturing processes, they will, however, prove of less attraction to the visitor than the show-rooms; the extent, loftiness, and handsome appearance of which may be judged of to some extent by the illustrations of their interiors given on this and the preceding page. Messrs. Rodgers & Sons, it is worth recalling, were the first firm in the Cutlery Trade to open such a department, and when this was done, now more than sixty years ago, it was regarded by competing firms as an uncalled-for innovation. However, the example thus set has been since universally followed, and this is but one of many illustrations which might be adduced of the manner in which the Firm under notice have been always in the van so far as the introduction of improvements has been concerned. These show-rooms are filled with some of the choicest productions of the Cutler's art. Here may still be seen the "Norfolk knife," which excited much astonishment and elicited universal admiration at the Exhibition of 1851. It contains seventy-five blades, on which are given etchings of Her Majesty the Queen, the Prince Consort, views of Windsor Castle and other royal residences, and a variety of different subjects. The handle is formed of carved pearl, representing a Boar Hunt on one side and a Stag Hunt on the other. A still greater curiosity is a knife containing as many blades and other instruments as there are years in the Christian era. Many other exquisite examples of craftsmanship there are, representative of the various branches of the business, and, as the visitor wanders from room to room he is at a loss which article to admire most, there being such a wealth of charming works in steel as well as electro-plated ware, which latter branch of manufacture is also carried on by Messrs. Rodgers & Sons with marked success. Fitted up in elegant style, these show-rooms have proved a centre of attraction to many royal and other distinguished visitors, including the Prince and Princess of Wales, the late lamented Prince Leopold, and, still more recently, Prince Albert Victor. For well-nigh a century Messrs. Rodgers's goods have been patronised by the Royal Family of this country, and, as long ago as the year 1821, the Firm were appointed Cutlers to the Court, while, as recently as 1884, this special appointment was renewed to them. Meanwhile they had received a similar distinction from the King of Sweden.

Prize Medals have also been conferred upon them for their manufactures at every Exhibition at which these have been shown, and the fame of the Firm has been thus spread abroad throughout the whole world. It may be confidently averred that for variety, excellence of quality, tastefulness of design, superiority of workmanship, and beauty of finish, the Cutlery of Messrs. Rodgers & Sons stands unrivalled. It is a well-known practice for Sheffield manufacturers to stamp their productions with the names of the retail dealers for whom they are intended. This custom has brought with it much deterioration of the quality of goods. The Firm under notice, alive to this evil, supply no article—be it table-knife, fork, razor, penknife, &c.—which is not impressed with their own name and trade-mark, as reproduced on one of the preceding pages. It is thus that their name has come to be universally regarded as a voucher of the highest excellence. Unprincipled persons have, however, not been wanting who have taken advantage of their high repute, and have sought to palm off as that of the Firm inferior cutlery, bearing a colourable imitation of Messrs. Rodgers's trade-mark—a species of imposition against which customers cannot be too much on their guard.

As we have shown, Messrs. Rodgers & Sons have during two centuries taken the lead in connexion with the Cutlery Trade, and, under the able and energetic administration of Mr. Robert Newbold and his son, Mr. Arthur Newbold (the two managing directors), the Firm continues still to hold its foremost rank, and has materially aided in securing for Sheffield that pre-eminence in this branch of industry which she has so long enjoyed.

Messrs. Humber & Co., Beeston, Nottingham.

AMONGST the new manufactures that have sprung into existence during the last two decades the Cycle industry must be granted a foremost place. It already gives employment to thousands of workpeople, and as Cycles have now become articles of utility, as well as means of enjoying healthy exercise, their manufacture has already attained a permanent character, with every prospect of a still greater development. No single person has had more to do with this desirable result than the founder and senior partner in the Firm whose name heads this page. Mr. Thomas Humber has laboured long and conscientiously to make his name a household word for reliable work amongst the thousands who enjoy the pleasures of Cycling. His career is another example of the man who, by unremitting perseverance, has worked his way to a proud position in the manufacturing community who contribute so largely to the prosperity and influence of our country.

Mr. Thomas Humber started business for himself nineteen years ago, and became at once his own master-foreman, leading hand, and staff; he is now the guiding spirit in a noble factory employing between 300 and 400 workpeople, and this number could be largely augmented if they had larger premises. The success of Messrs. Humber & Co. (at the present time consisting of Mr. Thomas Humber and his partner, Mr. Lambert) is due to the sterling character of their work; and no greater proof is needed of the truth of this than the fact that they have never exhibited in competition with other Firms without obtaining the highest awards. Fifteen gold, silver, and bronze medals testify to the appreciation of the judges.

It is not in this alone, however, that Messrs. Humber & Co. claim honours. An analysis of the National Cyclists' Union Records,—in which cognisance of all noteworthy authenticated Cycle rides is taken,—shows the most satisfactory results with, and the great merits of, the Beeston Humber machines. It is no exaggeration to say that such unprecedented records cannot be shown by any other Firm in the Cycle trade, and is ample justification for our having selected this Firm to represent the Cycle manufacture in the pages of this volume.

The Works of Messrs. Humber & Co. originally started in Nottingham, but are now located in Beeston, a village three and a half miles from the lace metropolis. The Works are newly erected, and consist of offices, engine-room, boiler-house, iron and brass foundry, six large turning and erecting shops, forge, glazing, grinding, polishing, and pattern shops, nickel-plating plant hardening stoves, enamelling and painting shops, besides numerous stores and packing sheds. Order and regularity in the Works are rigidly enforced by Mr. Humber, who evidently believes a slovenly workman to be a bad one. As a large number of the employés live in Nottingham, the Firm have provided a mess-room to hold 300 comfortably seated, and with all necessary cooking appliances, together with an abundant supply of hot and cold water. Assistants are provided to cook the meals and keep the place clean and comfortable, and the whole cost is defrayed by the Firm. In the evenings the

room is utilised as a gymnasium or reading-room, and on Sundays is usually lent to one or other of the religious bodies in the village who may be in temporary want of a room.

The productions of the Firm consist of ordinary bicycles for the road or racing path, safety bicycles tricycles, and tandems. Each of these have been specially designed by Mr. Humber, whose highest ambition has always been to produce Cycles which shall combine the requisite strength with the least possible weight compatible with safety for the rider.

The Ladies' Cripper, which has ever been popular since its introduction four years ago, can be ridden

THE CRIPPER TANDEM.

by either lady or gentleman; it has 36 or 40-inch driving-wheels, adjustable handle-bar and seat-support for various heights; patent automatic steering, allowing freedom for the hands; patent anti-vibration spring in the frame, which prevents all vibration on the hands from the front wheel. This machine has been ridden 200 miles in one day by a lady, and 251 miles in one day by a gentleman.

The Cripper Automatic Steerer for gentlemen (illustrated on the next page) has 36-inch driving-wheels, 22-inch front-wheel, central driving and balance-gear, and has four bearings on the main axle to equalise the weight. This machine was ridden from Land's End to John-o'-Groat's, 861 miles, in five days ten hours, beating the best previous time by one day five hours.

The Cripper Tandem, shown above, is for two riders, either ladies or gentlemen. This machine was introduced in 1887, and is very much appreciated by ladies.

The ordinary Humber Tandem is at present the fastest tandem on the road. In a fifty-mile contest

on the Great Northern Road, June 19th, 1886, open to riders of all classes of machines, the two first past the post were machines of this pattern, coming in sixteen minutes before any other bicycle, tricycle, safety bicycle, or other tandem. On another occasion one of these tandems was ridden fifty miles in two hours and forty-six minutes, the fastest time for this distance on any class of machine.

The ordinary pattern Humber is, without doubt, the machine which gave a permanent character to tricycling, and prevented the pastime dying out when the novelty of bicycle riding was passing away. This tricycle, not being patented, was copied by every Cycle manufacturer of note, and, until the introduction of

THE CRIPPER TRICYCLE.

the Cripper, was highly appreciated. It is a very good wearing machine, and its construction is so simple that there is but little fear of it getting out of order.

In the Humber Safety Bicycle the seat is placed so far back that falls over the handle-bar are impossible, and the rider is so close to the ground that a side-fall is of little consequence. The frame of this machine is so designed as to withstand the numerous side-twists and strains which machines of this type have to undergo.

The Humber Special Roadster Bicycle is used by all the best amateur and professional riders of the year. This bicycle has been ridden on several occasions in record journeys from Land's End to John-o'-Groat's, and has carried the riders without any mishap whatever, no spoke having come loose or nuts lost on the journey.

The "Times."

THE *Times* has celebrated its centenary, and its Commemorative Medal will go down to posterity among the historical relics of the Victorian era. The paper was started in 1785 by Mr. John Walter, the grandfather of the present proprietor, who is also named John, and who until recently had a seat in Parliament. From the first inception of the paper until the present day the conductors have availed themselves of every possible invention which had for its object the advancement of the art of rapid printing. The founder began the mechanical work of the establishment with a scheme which he called "logographic printing." His idea was to have words, affixes, prefixes, and even phrases cast *en bloc*, so that the printer could pick them up in solid pieces, instead of lifting them into his "stick" in separate letters. But to accomplish this Mr. Walter's cases of type were too extensive for practical manipulation. He had calculated that the English language consisted of about 90,000 words. To reduce this number in the compositors' hands to 50,000 was an ingenious fancy, but it was only a fancy, holding possession of the inventor's brain for three years, and costing him some thousands of pounds. Though his mechanical ingenuity in this direction did not achieve a practical success, the *Times*, nevertheless, evinced a far-seeing comprehension of what was required in a great national newspaper. In this respect the famous journal had no failures. It was always alongside the progress of the age, sometimes in advance of it. No opportunity for extending its interest was ever missed, and, above all, it maintained in face of official opposition and Governmental obstruction, which sometimes descended to persecution, a tone of fearless independence. The *Times* was the first to introduce both machine and steam printing. Until 1814, the rate of production was not more than 300 copies per hour. The statement of a young German, named Kœnig, that he had designed a machine to print at the rate of 800 an hour, was scouted by all the London newspaper proprietors, Mr. John Walter, the son of the founder of the journal and its then manager, excepted. A printer named Bensley gave Kœnig a room in his office in which to work out his idea. Kœnig had travelled through Germany and Russia without meeting with either attention or consideration, although he had been able to explain himself in those countries, while in England he was a foreigner indeed, not able to speak the language, and having no friend to help or introduce him. Mr. Bensley kept him at work for three years, at the end of which time he had perfected his model and patented it. In 1811 it was exhibited as a working fact, and it proved its capacity of 800 an hour to the full. Mr. John Walter ordered two of the machines, and on the 29th of November, 1814, the *Times* was printed by steam. The demand for the paper still exceeded the capability of supply. Hitherto its pages had to be set up in type twice or thrice over to meet the sale, and even with the abolition of the hand-press only five or six thousand copies could be struck off in time to maintain the freshness of the day's intelligence. Some writers on modern progress have gauged the culture and desires of the public seventy years ago by the limited circulation of the newspapers, the *Times* in

particular, forgetting that the demand was far ahead of the supply. As fast as the *Times* increased its issue the public bought it, and as the paper grew in popular estimation so did the conductors extend the area of its operations as a news sheet and an organ of public opinion. The two departments, editorial and mechanical, advanced hand in hand. If they had been in perpetual rivalry, to the extent of a hostile competition, they could not have shown more energy of action. In spite of the vast and rapid progress of production in America, there is no newspaper establishment in the world more perfect in its appliances than that of Printing House Square. In many instances the new inventions which have been adopted in America and elsewhere have first seen the light in the *Times* office. Long before an attempt was made to introduce the type-setting machine in other countries it was a part of the *Times* machinery.

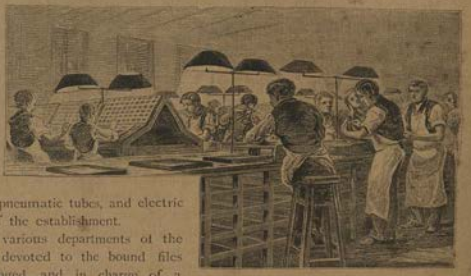
MR. JOHN WALTER.

The public which reads its *Times* over breakfast has but a vague idea of the stupendous organisation necessary to its production. A little army of correspondents, telegraphists, and agents of all kinds is engaged in its service beyond the seas; while at home quite a multitude of editors, leader-writers, critics, reviewers, reporters, clerks, book-keepers, and others, from men of the highest culture down to the humblest messenger, constitute its daily staff. The *Times* office is not only a printing establishment, it is an engineering manufactory. The "Walter" machines, upon which its own pages are printed, were invented and made at Printing House Square,

THE "TIMES" OFFICE.

as were also the presses used by the *Daily News*, the *Scotsman*, the *Liverpool Post*, the *New York Times*, and other well-known journals. There is nothing in the way of type and machinery which the *Times* does not manufacture for itself, and the electric lighting of the building was carried out on the spot by its own engineers. The *Times* was the first to use the new light in London, which is entirely in keeping with the previous history of the administration of the paper. There is no more self-contained house in the world. The whole of the new buildings were designed by Mr. Walter and his lieutenant, Mr. J. C. Macdonald,

without the extraneous aid of architects or contractors. Even the bricks were made on Mr. Walter's estate at Bearwood, and conveyed to London by his own people. The reconstruction of the place was carried on with a remarkable ingenuity that obviated all interference with the hourly work of the various departments. The new building gradually took the place of the old one, and is now as perfect and easy in its working as if type-setters, telephones, stereotypers, pneumatic tubes, and electric lamps had always been part and parcel of the establishment.



THE "TIMES" COMPOSING-ROOM.

It is worth while glancing at the various departments of the *Times* building. The highest floors are devoted to the bound files of the paper, which are carefully arranged and in charge of a librarian; on the next floor are kitchens and dining-rooms, designed and conducted for the employés, one department being set apart for the clerks, and another for the compositors, machine-men, and engineers. The service is conducted so as to pay its way, but without profit, thus providing the workpeople with good, wholesome food at a minimum cost. The joints are all cooked on spits before the fire, and the *chef* and his staff appear to take a laudable pride in their work. Descending to the next floor we pass through a range of store-chambers, and presently enter upon a series of fine electric-lighted composing-rooms. One is struck by the absence of bustle and commotion in every department. Further on we find what may be called experimental rooms, where new inventions of various kinds are on their trial; then we enter an office devoted to the Paris wire, with a compositor working a type-setter which puts up the dispatches direct from the original messages. Close by is the telephone-room connected with the Houses of Parliament. The stenographers' notes are read off at Westminster through the telephone. At the *Times* office the messages are dictated to the type-setters. Later in the night the original manuscript of the short-hand writer comes up from the Houses, and the proofs are read by it, thus completely checking the telephonic dictation. The editorial and writing-rooms are relegated to the storey below. For the distribution of copy, proofs, and messages, a pneumatic tube runs right through the whole of the premises. The printing-machines are on the ground floor, and they are laid down in pairs in case of accident. Opening into the machine-room are the foundries and publishing offices, arranged so as to facilitate rapid printing and quick distribution to the public. The pages come down from the upper floors by lifts; they pass into the stereotyping-room, and thence to the machines, whence the papers are wheeled into the publishing office, which is opened every morning at four o'clock, the porters and carters

TYPE-SETTING MACHINE.

of Messrs. W. H. Smith & Sons being the first recipients of the vast bales which they send out to all parts of the world. Fronting these departments, and facing Queen Victoria Street, are the advertising offices and "letter inquiry department;" here there is a numerous body of clerks, constantly occupied at the receipt of custom. The chief official has the command of a telephone communicating with the Royal Exchange and the offices of all the leading advertising agents.

It is almost impossible to give an approximate estimate of the value of the advertising sheets of the *Times*, nor does it come within the object of this article to do so; but it is interesting to recall the fact that when a stamp duty upon advertisements was enforced by the Government, the *Times* paid in one year (1830) into the Treasury the sum of £70,000. It has been calculated that if on its present sale and number of advertisements the *Times* had to pay the old tax on advertisements, as well as the penny stamp on each issue, it would have to contribute to the Government over £450,000 a year. The best and most recent information concerning the working of the *Times* is contained in Grant's "Newspaper Press," and Joseph Hatton's "Journalistic London." Taking Mr. Grant's figures for advertisements, and a minimum sale of 70,000 copies, the annual returns of the great journal amount to not less than £1,036,000.

Figures appeal to the general imagination; but it is not alone by any means as a commercial undertaking that the *Times* must be judged. It has been well and properly described as "the leading journal of Europe," and

THE "TIMES" PRINTING-ROOM.

its history is that of the rise and progress of the newspaper press. It has exposed and fought monopolies, abuses, and frauds; it has maintained its independence in spite of official intimidation, espionage, and corruption; it has upheld all that is good and great in the Constitution, and has never lost sight of the Imperial traditions and grandeur of the nation. The Walters have all been strong men, and in their labours they have invariably associated with themselves the best advisers and writers that wisdom could select or money secure. In the days of the second Walter the paper had for its personal antagonist the powerful Minister, William Pitt, who did all he could to crush the press in general and the *Times* in particular. But the stubborn nature of the management waxed more and more independent under persecution. Mr. Pitt put an end to the opposition of the *Courier* by purchasing it—lock, stock, and barrel—and converting it into a Government organ. The *Sun* arose under "the divine minister's" inspiration. The *Times* had shared the business of Government printing. The contracts were taken away in 1803 from the unbending Walter, and there was no end to the little annoyances to which he was subjected in order to force him into the meek position of a ministerial organ. But the paper throve on persecution, and as Mr. Walter increased the power of production the *Times* grew in circulation, and found in an appreciative public a far more valuable ally than that of Pitt or any other Minister.

Dr. Stoddart may be said to have been the first recognised editor of the *Times*, outside the proprietor. He was a powerful writer, but was lacking, perhaps, in discretion. His craze against the first Emperor Napoleon tended to lower the dignity of the paper, and a successor was found in Mr. Tom Barnes, who sat in "The Thunderer's" chair with distinction and success for many years, followed, at his death, by Mr. John Thadeus

Delane. Between these two appointments, Mr. Walter offered the chief position to Southey, the poet, who, besides being a man of wide and precise knowledge of public affairs, wrote prose with as much grace and vigour as he wrote poetry. Two thousand a year in those days was a princely sum for a writer, and this was the stipend which Mr. Walter offered Southey, who, however, intimated to the friend through whom Mr. Walter made his proposal, that no emolument however great would induce him to give up a country life and those pursuits in literature to which his studies had been for many years directed. To-day, however, there are few authors or poets who are not willing to take a share of the honours and emoluments of newspaper work, though many are still to be found who would hesitate to sacrifice their time and personal leisure on the altar of the editorship of the *Times*. There can be no more absorbing or exacting work. Mr. Delane, whose name more than that of any other editor will probably always stand first on the *Times*' roll of history, was at its head for thirty-six years, and when he retired in 1877, the loss to the country and to journalism was regarded as one of the greatest calamities of the year. A foremost man in political society, Mr. Delane, nevertheless, invariably stayed at Printing House Square every night until the *Times* went to press. He was a trusted friend of Lord Palmerston, and a frequent visitor at Broadlands. He had been assistant-editor under Mr. Barnes, and was the son of the financial manager of the paper. A trained journalist, he was a scholar of some distinction, having been educated at Oxford, and, in due course, called to the Bar. Mr. Thomas Chenery, M.A. of Cambridge, was the next editor, and on his death in 1884 Mr. Buckle, the present editor, came into power, carrying on the succession with an abnegation of self which is peculiarly characteristic of the anonymity of the staff of the leading journal. The non-personality of the writers for the *Times* is one of the traditions of the paper which is most jealously watched and guarded. Mr. Grant, in his chapters on the *Times*, regarded "the circumstance of maintaining secrecy as to the writers of leading articles as one of the causes to which the enormous moral power and commercial success of the *Times* are to be ascribed." We have no desire to break in upon the anonymous character of the *Times* staff, but there are several names, past and present, connected with the paper which, in cultured circles, will always be associated with its fame and power. Captain Sterling was the leader writer who won for the *Times* the sobriquet of "The Thunderer;" Lord Beaconsfield wrote its "Runnymede" papers; Sir William Harcourt is its "Historicus;" Lord Sydney Godolphin Osborne will be remembered for his varied contributions signed "S. G. O.;" Lord Sherbrooke was one of its leader staff; Mr. John Oxenford was its dramatic critic; to-day M. Blowitz is known throughout Europe as its Paris correspondent; and Dr. W. H. Russell will go down to posterity as its "Pen of the War."

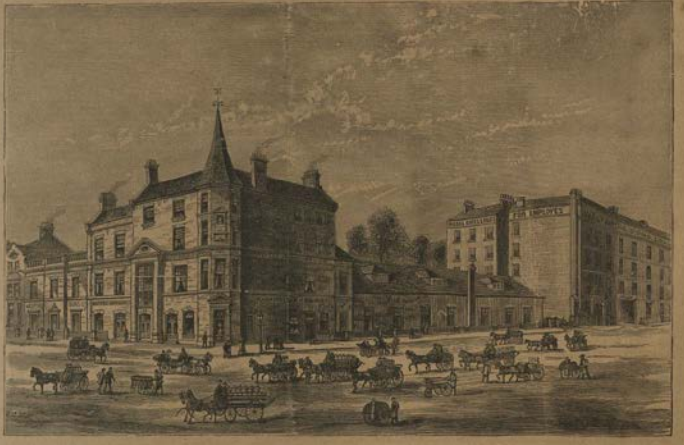
Messrs. Welford & Sons, Limited, London.

IT would be difficult to over-estimate the value of milk as an article of food, since it can support and increase the growth of the young of every species of mammalia, at once supplying materials for the formation of the bony, fleshy, and liquid portions of the body. The substances present in milk are wonderfully adapted to its office of producing materials for the rapid growth and development of the animal frame. It contains nitrogenous matter nearly identical in composition with muscular flesh, fatty principles, a peculiar sugar, and various salts, including phosphate of lime held in complete solution in a slightly alkaline liquid. When milk is examined under the microscope, it is found to consist of numberless globules, which are suspended or float in a colourless fluid. From these globules milk derives its opaque whiteness: consequently, when it is diluted with water and the fluid increased in proportion to the globules, the rich whiteness of pure milk is destroyed, and the liquid assumes a more or less bluish or semi-transparent appearance. These globules principally consist of the oleaginous fatty or creamy parts of the milk, but they also contain curd or caseine; this constituent, however, chiefly exists in a state of solution in the serous or fluid portions of the liquid along with the sugar and salts. Thus we have milk consisting of water, which holds the other constituents in solution; of caseine, the nitrogenous or flesh-forming and force-giving element; of sugar and fat, heat and force producers; and of mineral matters. Berzelius states that cow's milk of average quality contains from 10 to 12 per cent. of solid matter when evaporated to dryness by steam heat. The average cream of cow's milk contains 4·5 per cent. of butter, 3·5 per cent. of curd, and 92 per cent. of whey. The skimmed milk consists—of water, 92·9 per cent.; curd, 2·8 per cent.; sugar of milk, 3·5 per cent.; lactic acid, lactate of potassa, and a trace of lactate of iron, 0·6 per cent.; chloride of potassium, phosphate of potassa, and earthy phosphates (lime), 0·2 per cent. These constituents are all required for the building-up of the body, and milk is the only single article of diet which can sustain life for a lengthened period.

Upon unadulterated milk any infant will thrive; but it is well known that many unprincipled tradesmen have made the adulteration of milk their special study; indeed, it was once believed by country people that pure milk was an article unknown to the inhabitants of the Metropolis. The late Mr. Welford (father of the eminent dairy reformer, Mr. John Welford), commenced business in Paddington in 1845, a time when nearly all cowkeepers adulterated their milk. Acting on the principle that honesty is the best policy, he determined to stand or fall by pure milk and genuine dairy produce. It was no easy task to fight against an army of unscrupulous dealers, who were not satisfied with small profits; but Mr. Welford, senior, managed to hold his own, and by degrees he established a good business and a reputation for fair and honest dealing.

The present chairman of Welford & Sons, Limited—Mr. John Welford—arrived at man's estate when sanitary reformers were beginning to study the causes of zymotic diseases, and inquiring into the sanitary state of stables and cow-sheds. A great deal was written and talked about, but little was done in the way of

improving, the dairies of the Metropolis. Mr. Welford found a gap that was not filled up. He grasped the situation at once, and entered upon an extensive undertaking which might have appeared impracticable to men of less pluck and determination. His father had built up a reputation by supplying pure milk to his customers. The field was too small for the son, who was convinced that a model dairy farm in the Metropolis, fitted up and managed in accordance with modern scientific principles, would be a success. In 1879 he was joined in the business by his two brothers, Mr. R. W. Welford and Mr. F. R. Welford, and with their assistance he began to carry out his great scheme; but it was not until April 12, 1881, that the foundation-stone of the splendid block of buildings in Elgin Avenue, Maida Vale, was laid by his little daughter, Miss Annie F. Welford. The opening ceremony was attended by a number of eminent gentlemen, including Dr. T. Lauder Brunton, F.R.S., Dr. B. W. Richardson, F.R.S., Dr. F. A. Mahomed, Dr. J. Milner Fothergill, Rev. Marshall Tweddell, Professor Plumptre, Dr. Danford Thomas, Dr. G. Gwynne Bird, Mr. F. H. Fowler (Deputy-chairman, Metropolitan Board of Works), Dr. Stamford Felce, Dr. Lovitt, Dr. Walker, Mr. A. W. Stokes, F.C.S., Dr. Wynter Blyth, Dr. Eccles,



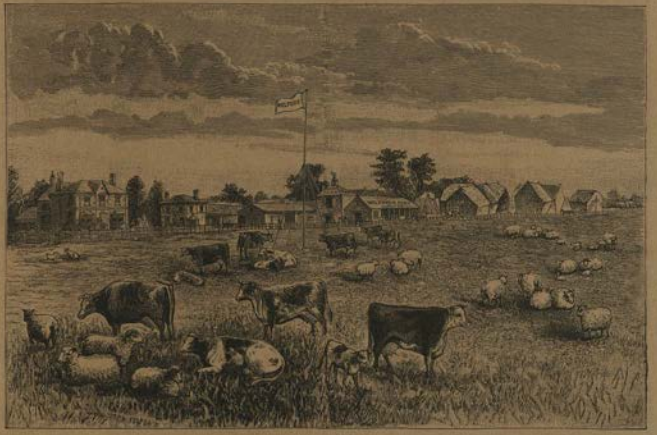
MESSRS. WELFORD AND SONS' DAIRY, ELGIN AVENUE, MAIDA VALE.

Dr. Knott, and Dr. Ray, the stone commemorating the completion being laid by Thomas Clarke, Esq., one of the Sheriffs of London and Middlesex. It may seem strange to the uninitiated that so many distinguished men of science should assemble to celebrate the completion of a dairy; but, by all who understand the laws of hygiene, the establishment under the direction of Messrs. Welford is acknowledged as an institution of national importance, and, on the occasion of the completion of Mr. Welford's undertaking, the men of science rallied round the Dairy Reformer to mark their appreciation of his labours and to encourage him to continue his good work.

Many of our readers had an opportunity of enjoying the splendid exhibit of cows, dairy machinery, and produce of Messrs. Welford at the International Health Exhibition in 1884. It proved the chief attraction to thousands of persons, and it was a revelation in dairy-farming. On many days visitors had to wait their turn to get a look at the beautiful Jersey cows; the wonderful separator, with its two pipes, one delivering cream and the other skimmed milk at the rate of sixty gallons an hour. All day long the counters were thronged by persons anxious to taste the whipped cream, or the rich milk fresh from the Channel Island cows. This was a reproduction, in miniature, of Messrs. Welford & Sons' scientific dairy at Elgin Avenue, Maida Vale, which is one of the show-places of London, and is visited by most persons interested in matters of hygiene,—including Royalty,

for the Princess Louise and her husband inspected the principal dairy about a year ago, when they expressed their approbation in terms very flattering to the management.

Pathologists have discovered that the bacilli of tuberculosis, or the microscopic organism popularly known as the germ of consumption, may be conveyed to the blood of a healthy person by the milk taken from a consumptive cow. It is well known to sanitary officers that cows condemned to live in badly-drained and ill-ventilated London sheds are subject to diseases of the lungs. This is a very serious matter, and a subject that ought to be freely discussed by the laity as well as by the members of the medical profession. Milk of a mother labouring under strong mental emotion is capable of seriously endangering the health of the suckling babe. Payne narrates the case of a woman suffering under a nervous affection whose milk two hours after an attack of the disease became viscid like the white of an egg. Similarly a deterioration and consequent alteration in properties is induced in the milk of the cow if she be overdriven, exhausted, or harassed. The food of the animal likewise exercises an influence on the quality of its milk. Thus, when cows are fed on turnips, decayed



HOME FARM.

leaves, cabbages, or onions, the flavour of these substances is imparted to their milk. Mothers ought to know that in the feeding of their children one very important particular to be attended to is the employment of pure cow's milk obtained from a healthy grass-fed animal only. With this precaution the infant will thrive as well as on the breast of any human female excepting its mother's. Messrs. Welford & Sons' Jersey cows supply this kind of milk. The stables of these animals are luxuriously fitted up, their food is of the very best quality, and the air they breathe is as good as that of the most favoured child of wealthy parents.

We have referred to the danger of drinking milk drawn from a consumptive cow. Before dismissing the subject of contagion, we must not omit to mention the fact that it is of the utmost importance that the sanitary condition of the men and women who work on dairy farms should be carefully attended to. How many dairymen in the metropolis know or care anything about the health or the state of the dwellings of their servants? If they keep their time in the morning, and perform their duties steadily, nothing more is required. Mr. John Welford has introduced another new and important feature in dairy-farming. Adjoining the chief scientific dairy at Maida Vale are substantial model dwellings for the employés of the Company. A medical officer is attached to the premises, so that every man is carefully watched, and only allowed to work at the dairy or farm when

he is in perfect health. The same rule applies to members of the man's family, his wife being responsible for the cleanliness of her apartments. Scarlet fever has been conveyed by means of the throat discharges and cuticle falling into the milk from the persons of servants and others employed in dairies: so the importance of Messrs. Welford's model dwellings for their workpeople, and the strict watch kept over them, will be understood and appreciated by our readers.

The washing and scouring of the cans and other utensils used for the reception of milk are done by machinery, and so thoroughly are these vessels cleansed before they are refilled, that it would be impossible to find anything sweeter than the milk-cans, &c., after they have been subjected to the scouring process. The water with which the vessels are rinsed is the same as that used for drinking in the neighbourhood of Kilburn, and the drainage of the dairy is simply perfect. Milk has been proved, on several occasions, to have been the cause of spreading disease, through the vessels containing it having been previously rinsed out with water contaminated with sewage-poison at badly-drained dairies. Several outbreaks of typhoid and scarlet fevers have been clearly

MR. JOHN WELFORD.

traced to this cause: hence the vital importance of a perfect system of drainage at all places where dairy utensils are cleansed. After the cans are scoured at Maida Vale they are purified and dried by steam.

To write more about the sanitation of Messrs. Welford's dairies would be like "painting the lily," or adding "a perfume to the violet, or gilding refined gold"; we will dismiss this important subject by quoting an extract from the report of the Government Inspector after a visit to Welford & Sons' dairies:—"I have never seen a finer or more excellent dairy of cows. Their health is all that can be desired. The sheds are roomy, well ventilated, and kept particularly clean."

Worked by a powerful steam-engine are the butter-making machines,—a great improvement upon the old-fashioned churns. The butter is never handled during the process of churning or washing. Its quality cannot be surpassed, and is rarely equalled. A large quantity of butter is made every day, as well as a good supply of the very best English cream cheese we have ever tasted.

Many persons, particularly ladies, are fond of Devonshire cream. There is a general impression that clotted cream cannot be properly made in London. If the sceptics would take the trouble to visit Messrs. Welford's dairy at Maida Vale they would soon be convinced to the contrary. There is no need to send to

Devonshire, or wait for consignments of clotted cream: any quantity of that luxury can be obtained at all hours of the day from Messrs. Welford & Sons' chief and branch dairies.

Among the specialties of this eminent Firm may be mentioned the preparation of Koumiss, originally the product of the natural fermentation of mare's milk. Koumiss has been used for ages by the natives of Tartary as an article of fluid food. It has latterly come into much favour as a nutritive remedy in cases of obstinate vomiting attended with debility and emaciation. It is now prepared by Messrs. Welford from cow's milk, and is a highly refreshing, agreeable, and valuable beverage.

Another important preparation is the Artificial Human Milk, first suggested by Dr. Franklin and Dr. Playfair, by the employment of which, Dr. Playfair writes, "the risks and disadvantages of the bottle-feeding of infants are reduced to a minimum." He looks upon it as immeasurably superior to ass's milk, being much cheaper: and he considers that if the preparation were more generally known and used, much illness in the case of children who cannot be brought up at the breast would be avoided. Goats are kept to supply families who prefer the milk of these animals, which, for the most part, resembles cow's milk, but its consistence is greater, and it contains much more solid matter.

As Messrs. Welford & Sons supply over 10,000 customers with dairy-produce in London, they are obliged to maintain other farms besides their home farms at Willesden, which are "surrounded by 300 acres of some of the finest grazing land in England." They employ a large staff of veterinary surgeons, whose duty it is to visit the farms and examine the cows. At the head of the veterinary staff is Mr. J. Woodger, M.R.C.V.S., and the Medical Department is in charge of Dr. T. Lauder Brunton. New-laid eggs are received daily at the branch establishments from the dairy farms. Messrs. Welford & Sons do an extensive business in cattle and dairy utensils. They retain about forty clerks to keep the accounts of the Company, and the number of farm-servants employed directly and indirectly by this Firm is very large. All their horses are well fed and groomed; the carts are clean and kept in good repair by the Company's own mechanics. The managerial arrangements are systematic, and perfect order reigns in every part of the dairy farm. Messrs. Welford & Sons supply (by appointment) the members of the Royal Family, and there is every prospect of their already large *clientèle* being increased as their fame becomes more widely spread, although at the present time the Messrs. Welford may well feel proud as they survey the splendid pile of buildings whose origin and scientific and hygenic features, as well as the immense success of the business, are due to the extraordinary efforts they have made in the cause of Dairy Reform.

Mr. Alexander Dick, London.

"DELTA" was the name given to the now well-known series of peculiar alloys by the patentee and manufacturer, Mr. Alexander Dick, of Cannon Street, London, with the idea of connecting the same with his own name, Delta being the Greek for D, the initial of the inventor's surname. In his researches leading to the invention of Delta Metal, Mr. Dick was influenced by the experiments of Mr. Aich and Baron Rosthorn, of Vienna, who some twenty years ago attempted to improve copper-zinc alloys by introducing a small percentage of iron. The results tabulated by Dr. Percy in "Iron and Steel" show that the alloys obtained possessed remarkable strength and tenacity; and it seemed strange to Mr. Dick that, with such valuable qualities, they did not come into general use. A London brassfounder informed Mr. Dick that he sometimes obtained excellent results with these alloys, and at other times the results were the very reverse, in spite of, as he thought, manufacturing them in identically the same way. The alloys were ultimately abandoned on account of this uncertainty.

Mr. Dick produced various quantities of the alloys by dissolving wrought iron in molten copper, according to the Austrian method. The resulting alloys, however, varied greatly, simply because the iron dissolved varied in each parcel. He, however, succeeded in introducing a known and definite quantity of iron into the alloys, by dissolving the iron in molten zinc to saturation, and adding the saturated metal (with or without an additional quantity of pure zinc) to the molten copper. To deoxidise the metals, Mr. Dick added a small percentage of phosphor copper. In some cases Mr. Dick also introduces tin, manganese, aluminium, or lead into the alloy, to impart special qualities to it. By experiments, the most useful combinations were then ascertained, and alloys possessing special and very valuable qualities are now produced as Delta Metal.

The specific gravity of Delta Metal is 8·4, its melting point 1800°. In colour it resembles gold alloyed with silver. It can be worked hot and cold. When melted it runs freely, and the castings produced are sound and of fine close grain. It can be brazed like copper or brass. Cast in sand, it has a breaking strain of 21 to 23 tons, equal to wrought iron; the latter tensile was recently obtained by Messrs. Schweizerische, Locomotiv Fabrik, in Switzerland, who cast a number of heavy worm-wheels in Delta for the Pilatus Mountain Railway, no other alloy being found sufficiently strong. When forged at a dark-red heat, the breaking strain is raised to that of good Bessemer steel, 36 tons, and when hammered or rolled cold it will stand a strain of more than 40 tons per square inch. At a dark-red heat the metal can be stamped and punched like wrought iron or steel, and a great variety of articles hitherto cast in bronze or brass are now produced in this way, being cheaper than castings, three times stronger than brass, always perfectly sound, and requiring little or no tooling, as they leave the dies perfect, and in many cases ready for polishing. It is interesting to know that the iron introduced by Mr. Dick's process is really chemically

combined; this is proved by the alloy not rusting, and also by its having no influence whatever on the magnetic needle.

The applications of Delta Metal are very numerous. It replaces best gun-metal with advantage, and in many instances iron or steel, as it does not rust. Thus parts of rifles, torpedoes, sawing-machines, bicycles, links, levers, and other parts of machinery, &c, are now stamped in Delta instead of steel or iron. Spindles for pumps and valves, shafts, pump-rods, plungers, bolts, nuts, studs, &c., are forged extensively in the same alloy. A number of launches and torpedo-boats have been built in Delta Metal, from 21 feet to 40 feet long. We illustrate below one of these launches built for the German Colony in Central Africa. The plates and angles are of rolled Delta; stem, stern, keel, and propeller are forged of the same material. Delta being

even superior in strength, ductility, and toughness to the mild steel used for launch-building, all dimensions of material are the same as if steel was used. Launches and torpedo-boats built in Delta are, of course, practically incorrodible.

Several hundred steamers, as well as pumping machinery, locomotives, &c., are now fitted with Beldam's Corrugated Valves in Delta Metal, and most remarkable results obtained. In ss. *Kent*, after steaming 170,000 knots, the valves are still in good working order; ss. *Kenia* is now on her twelfth voyage to Calcutta with the same valves; ss. *Sussex*, after two years work, the valves are reported to be in good order.

Delta Metal under ordinary circumstances does not draw verdigris, which quality makes it particularly valuable to Sanitary and Waterworks' Engineers, Brewers' Engineers, &c., for water meters, filters, tanks, &c.

Messrs. Priestman Bros., London and Hull.

THE immense development of trade in the products of the world which has taken place within the last hundred years, but more especially within the fifty years of Her Majesty's reign, has made it needful to use every means to check those elements of nature which tend in any way to hinder this development. For thousands of years tidal action has, in numerous instances, accumulated sandbanks and gravel-banks, commonly called bars, at the mouths of rivers, the result, in many cases, being that as harbours and docks have been made and opened out, it became evident, in the majority of these ports, that suitable appliances must be supplied for removing, more or less continuously, this silt or deposit, to enable ships with a deep draught to enter. The Italians and Dutch were the first on record, we believe, to adopt the system of dredging, and then it was only carried on by means of a leather bag the end of a long pole, which was sent down to secure whatever hand-labour could force into it.

It was in 1796 that Messrs. Boulton & Watt made the first steam dredger, and this was put to work in Sunderland Harbour, but even this machine was chiefly dependent upon buckets made of leather for the removal of the stiff, heavy mud or stones which it was required to lift. Since that time almost every harbour or dock has found it necessary to have one or more powerful steam dredger, capable of lifting, in some instances, thousands of tons per day.

Until the year 1877, however, the machines supplied for the various dredging operations were found to be in many cases very expensive and cumbersome, but in this year Messrs. Priestman Brothers, of Hull, patented a very simple and effective dredger, which, when needful, with a little alteration, can also be used as an excavator or elevator. This machine was found so effective, and has, since its introduction, been so largely adopted throughout the world, that we can hardly do better than show, by a number of illustrations, its various uses.

Woodcut No. 1 represents a powerful steam Hopper Barge, purchased by the Mersey Docks and Harbour Board, which is the largest dock undertaking in the world. Upon this steam hopper they had fixed four of Priestman's Patent Dredgers, which are able to lift about a thousand tons of mud in less than three hours. The barge is then, under its own steam, taken down the river, deposits the mud automatically, and returns again to dock. To more clearly illustrate to our readers the principle of this class of dredger, we show a woodcut (Fig. 7) of a machine at work, together with buckets and grabs (Figs. 2, 3, and 4). These are all implements of the same kind and principle, but are altered in detail to perform the different kinds of work. Fig. 7 is specially designed for harbour work, being propelled to and fro under its own steam. With a little modification these machines are adapted to various kinds of work, such as dredging docks, canals, rivers, cutting trenches, railway excavating, sinking bridge cylinders, lifting or elevating coal, grain, ballast, &c.

We show on our illustration Fig. 5, one of Priestman's excavators, which was used by Messrs. Lucas

and Aird in excavating the Alexandra Dock at Hull. Our Home, Colonial, and many foreign Governments have been quick to adopt the principle of this machine, and our great International Exhibitions have awarded Gold

FIG. 1.

Medals and Certificates, unmistakably showing the high appreciation the judges have of the adaptability of this system. Priestman Brothers, besides making a specialty of these dredgers, also supply barges of various types suitable for carrying them and the deposit which the dredgers raise, of which we show an illustration,

FIG. 2.

FIG. 3.

FIG. 4.

Fig. 6. Their customers, amongst others, include the Governments of England, France, Germany, Spain, Denmark, Brazil, China, Italy, &c.; and the number of repetition orders they continue to receive demonstrates very clearly that by inventing a machine of this kind they have supplied a greatly-felt want, owing to the

FIG. 5.

FIG. 6.

FIG. 7.

large development of trade and the great increase of docks and harbours, especially during Her Majesty's reign, of which this year is the Jubilee.

Priestman Brothers' Works are at Hull, and their London Office is at 52, Queen Victoria Street. They also have a Colonial Office in Melbourne at Robbs Buildings, Collins Street West.

Messrs. Evans, Sons, & Co., Liverpool.

PERHAPS in no branch of British trade has greater progress been made during the last fifty years than in that represented by drugs and chemicals. A half-century ago, the whole of the business under this head was in the hands of a few Firms, who owed their knowledge to a rough-and-ready training gained in and about the warehouse rather than in the laboratory; but the school to which they belonged has been succeeded by one in which distinction has to be gained by critical contemplation of past scientific discoveries, and ceaseless chemical experiment in the direction of enlarging upon their results. The modern Drug Trade demands that the man of business should be also more or less the man of science; for this reason, most of the old Firms have been supplanted by others, whose thinkers and workers are equal to a wider range of intellectual research. Among the few Firms who have survived the great but gradual process of change, by keeping pace with the new requirements, are Evans, Sons, & Co., the fiftieth anniversary of whose foundation in Liverpool was celebrated some four years ago. On the score of historical connexion they can claim an older origin still, being offspring of the London Firm of Evans & Lescher, whose direct association with the drug trade extends over a period of about a century. Although the partnerships are distinct, the two houses are intimately connected with each other; and by reason of their long existence, and also of their large operations and wealth, they may be taken jointly as typical of the wholesale drug trade in this country.

The relational changes which have occurred in the constitution of the two houses are worthy of record, and may be briefly sketched. The founder of the Liverpool Firm was Mr. John Evans, who, having served an apprenticeship to the trade in Worcester and London, was taken into partnership about the year 1818 by Messrs. Kempson & Yates, of King Street, Snow Hill, London, forming the Firm of Kempson, Yates, Evans, & Parkinson. A few years afterwards Mr. Evans left this Firm and joined Mr. Stable, under the style of Stable & Evans, in Wood Street, Cheapside, London. This partnership was dissolved about the year 1827, and in 1828 Mr. Evans took into partnership Mr. Joseph Sidney Lescher. This gentleman still survives as the senior partner of the London Firm, whose full style is Evans, Lescher, & Webb. He is in his eighty-fifth year, and may certainly be described as the father of the wholesale drug trade. It was in the year 1833 that Messrs. Evans & Lescher founded the Liverpool business as a branch of the London house. Two years later, Mr. Lescher retired from partnership in the Liverpool Firm, but the two houses have always had interests in common. On Mr. Lescher's retirement, Mr. John Evans introduced his eldest son, Mr. Thomas Bickerton Evans, into the concern, and, in 1840, two other sons, John and Edward—both of whom had been employed in the business since the date of inception—were admitted into partnership, from which time the style became Evans, Sons, & Co., and has so continued. The Edward Evans last referred to is now the senior partner in the Firm, and his portrait is herewith given. Having from the foundation of the concern taken a

very active share in its management and development Mr. Evans, in the year 1871, purchased a property in Denbighshire, and shortly afterwards retired from the active pursuit of business. He resides on his property—Bronwylfa Hall, near Wrexham—where, being a county magistrate, and exerting himself in promoting the affairs of the county, he is well known and highly respected as a country gentleman. Mr. John Evans died in 1865, and his eldest son, the Thomas Bickerton Evans before alluded to, a year later. This latter gentleman left two sons, both of whom, having served their apprenticeship, also became partners, but died early. Another son, Mr. Henry Sugden Evans, was made a partner about the year 1860, and became eminent in the scientific world. Having left the Liverpool branch, he took the management of the Montreal Firm, but died in 1885.

LIVERPOOL, 1833.

LONDON, 1833.

Mr John Hilditch Evans, another member of the family, retired from the partnership in the year 1871, on purchasing a property near Pershore, in Worcestershire, where, up to the time of his demise, in 1884, he lived a retired country life, and was universally esteemed. The Liverpool partnership now consists of Edward Evans and his four sons—John James Evans, Edward Evans, jun., William Paterson Evans, and Alfred Bickerton Evans.

Having given the personal history of the Firm we can now deal with the ramifications of its trade, which extend all over the civilised world, and embrace operations on a scale beyond the conceptions of the uninitiated.

LIVERPOOL, 1887.

LONDON, 1887.

The premises of the Liverpool house consist of three large blocks of buildings, conveniently situated near each other, the principal being in Hanover Street, one of the oldest thoroughfares of the city—in the last century occupied by merchants' residences. The Firm first began their career in Fenwick Street, and a glance at the sketch appended will show the unpretentious character of the building in 1833. Messrs. Evans subsequently occupied premises in Lord Street, but some years later moved to the Hanover Street block, which had been previously occupied by the Bank of England. Of this they have retained possession ever since. About twenty years ago, the premises were burned out, but the handsome stone front remained standing, and the whole of the back portion was rebuilt. The internal arrangements were altered and improved to meet the requirements of the business, and several additions to the building have since been made. The general offices, in their various sub-divisions, occupy the ground floor, at the front, and accommodate a staff of sixty to seventy clerks. The

private offices of the several partners are also on this floor, to the right of the main entrance. What is called the "Well," is in every respect an important portion of the premises, and commands the central position. It is roofed with glass, and overlooked from the top floors through a framework of glass extending along its four sides, the desiderata of airiness and light being, in a double sense, well supplied. The middle of the Well constitutes the "Country"-Packing-room, of which a view is afforded. The scene here is one of bustle and activity at all periods throughout the working day, as orders from all parts of the kingdom are promptly executed and despatched. On one side of the Well is the Export Packing-room, where goods intended for shipment are received and distributed from other departments; and on the opposite side the needs of the retail trade in Liverpool and suburbs are attended to in an equally spacious and suitably provided section. Each of these departments has its own staff of workmen and assistants, controlled by an intelligent head. The method and system adopted are such as to avoid the possibility of mistake or confusion in the conduct of business. The basement comprises the "Liquid," and "Essential Oil" rooms, where the same admirable order and routine

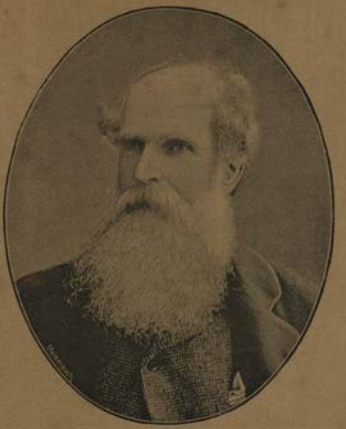
"COUNTRY" PACKING-ROOM.

are apparent in the storage and ready arrangement of thousands of valuable drugs and chemicals upon which demands are continually being made. In the Liquid-room are to be seen long tiers of shelves containing countless bottles, large and small, filled with rare spirits and essences duly classified and labelled; and in the Essential Oil-room earthenware and glass vessels of every capacity for the reception of essential oils similarly registered and marked. On the first floor is the Dry-room, where are stored in wooden boxes and bins all medicaments and drugs to be dealt with in their dry or more or less natural state; in other words, every article that can be done up and delivered in paper wrappings. On the first floor also is the "Oil-room," a department by itself, where numerous large tanks and filters witness to the wide trade of the Firm in this special department. Messrs. Evans were the first to devote a department specially to the Druggists' Sundries business, which had previously been a branch forming a distinct trade of itself, and, as such, it is still carried on by several well-known Firms. "Sundries," it may be stated, has to do with the fittings and furniture necessary to the complete equipment of the retail chemist and druggist, and to articles of stock, among which toilet and nursery requisites, perfumery, pomades, soaps, tooth-brushes, sponges, feeding-bottles, puff-boxes, and a thousand and one

miscellaneous things, are included. Goods supplied from this branch are only known to be Evans's by the Firm's registered trade-mark "Savars," which is universally accepted as a certificate of excellence.

Employment is here given to a large number of girls, who have a department assigned to them at the top of the building. The rest of the warehouse is devoted to the storage of drugs, chemicals, &c., in their crude state, and a most interesting and instructive task it is to look over this portion of the premises. The roof also is utilised for the purpose of bleaching castor-oil, of which no less than about thirty tons, contained in large glass bottles, are always exposed to the action of the light, the oil being afterwards conducted through iron pipes to filters in the Oil-room previously mentioned.

The Drug Mills and Laboratories, in Fleet Street, off Hanover Street, are probably the best-appointed Works of their kind in the kingdom. A large capital is sunk in modern plant and patent appliances, and most of the utensils are of brass or copper. Here are to be witnessed, in impressive and bewildering detail, the various operations of manufacture in connexion with numberless preparations which form staples of the trade,



MR. EDWARD EVANS, SENIOR.

but to minutely describe them would demand a mind stored with the knowledge of a practical chemist. Passing from section to section of these mills, the visitor's eye feebly attempts to realise the varied nature of the processes, but his nose has no difficulty in discovering, now a disagreeable smell or now a delightful odour, which better suggests an idea of the work in progress. Pill-making and coating by machinery is a feature which at once awakens interest. Formerly the retail chemist made by hand the pills he sold, but the machine-made pills he now obtains from Messrs. Evans are of better quality and yet cost him less. This mechanical pill-maker is a compact and ingenious contrivance, which works almost noiselessly. To keep it supplied with ingredients six men are constantly engaged, and it turns out an astonishing number of pills per day. It is startling to reflect that the woes of the human stomach should necessitate the production of pills on so extensive a scale. The manufacture of Citrate of Magnesia has a special department assigned to it, and also claims attention. Great care has to be taken in the treatment of the two ingredients of which the citrate is composed. When mixed they chemically re-act upon each other, and assume a granular form. The meshes of the sieves used are of silver, as an inferior metal would be subject to the influence of the

acid. It may be mentioned, to denote the expensive nature of many of the utensils, that these sieves are worth about £30 each, and the service of a number of them is required in order to meet the demand for the article. In the season the Firm's average manufacture of the citrate is two tons per week, and this quantity is often exceeded. A score of huge grindstones do the pulverising work of the mills. Considering the inflammable nature of their stock, Messrs. Evans have not, perhaps, been exceptionally unfortunate as regards fires; but some years ago their laboratories and mills were also destroyed by a serious conflagration. Nevertheless, with the energy which has given life to every period of their history, they immediately undertook the re-erection of the Works, and in the interim made ample arrangements to uninterruptedly pursue their trade. To show the extent of their business in this department, it is interesting to note that the Firm's consumption of spirits of wine reaches weekly an average of 500 gallons (overproof). The duty payable per gallon is sixteen shillings, showing the enormous contribution to the revenue of nearly £400 per week, or upwards of £20,000 per annum.

The self-sustaining principles of the Firm may be observed in every branch or division of their respective establishments. The effect is a consolidation of labour which imparts care and thoroughness to the whole concern. There is a room set aside for artists, who paint in gold the names of drugs upon

"SCULLING" ESSENCE OF LIMES.

stock-bottles required by the trade. A tinsmith's shop gives employment on the premises to a staff of workers in making boxes of that metal; wooden boxes, packing-cases, casks, and wicker baskets are also made by the Firm's own men; and even to the washing of bottles, this is done within the warehouse. They have their own stables, and keep many horses, wagons, and vans for conveyance of goods to docks, railways, and distant portions of city and suburbs. The Firm have likewise many workmen employed outside, and keep a Glass Works in Yorkshire going, besides Plaster Works elsewhere, all occupied in manufacturing solely for their business. They are represented in all parts of the world. They employ thirteen travellers for the home trade, three for the export, and have travellers in South America, India, and Australia. With respect to the London house, it is sufficient to remark that the interior arrangements of the recently rebuilt and extended premises are similar to those of the Liverpool establishments. From London is done the entire trade with the Eastern Hemisphere, viz., Australasia, India, &c.; while from Liverpool the Western Hemisphere is circumscribed, including a large business with the American continent. The two houses together practically have trading communications with all the civilised and uncivilised peoples of the globe; and by the Montreal Firm — Messrs. Evans, Sons, & Mason — the whole area of Canada is conveniently covered. By the wealth and enterprise which characterise the three allied Firms in every detail of their multifarious transactions, they forcibly illustrate the magnitude and dignity of British commerce.

But the extensive ranges of offices and warehouses in which the Firm carry on their business as wholesale and export druggists, do not embrace the whole of their trading operations. In the year 1869, the

attention of Messrs. Evans was drawn to the manufacture of Lime-Fruit Juice, which was coming into demand at that time chiefly as a medicinal agent in cases of gout, rheumatism, fevers, measles, and other diseases; but the difficulty being to procure a really pure article, they concluded an arrangement with Sturge's Montserrat Company, by which Messrs. Evans were appointed the sole consignees for the whole of the Lime Juice produced in the island by the Company and by their ultimate successors the Montserrat Company, Limited. Kingsley, in one of his books, speaks of Lime Juice as "that most useful of all sea-medicines" for the cure of scurvy, and to this end its properties have been appreciated for generations; but within the short period since its general introduction into this country by Messrs. Evans, it has become highly esteemed as a beverage in daily use. Montserrat, one of the Antilles islands, was discovered by Columbus, in 1493, and here alone, at the present time, is the lime systematically cultivated on a large scale. The plantations now cover upwards of eight hundred acres, which contain some 160,000 trees, and Messrs. Evans are now importers of nearly 200,000 gallons of pure Lime-Fruit Juice annually. The limes are gathered by the negro women, many of

LIME-JUICE FACTORY, LIVERPOOL.

whom will carry on their heads a hundredweight of ripe fruit for a distance of a mile or more. The juice is squeezed from the limes, put into casks, and shipped, in the raw state, to England, where, after being allowed to "settle," it is clarified and bottled in such a way as to keep it in sound condition for almost any period. Until Evans, Sons, & Co. gave an impetus to the manufacture, genuine Lime Juice was practically unknown, and even yet there no steady source of supply except at Montserrat. The factory of the Firm, where the raw juice, as imported, is received, is a large building hard by their Drug Mills. Here many hundreds of puncheons of the juice are stored, and fining, racking, and bottling are carried on. A stock is generally on hand of 140,000 to 150,000 gallons, and in the summer months it is often larger, for as a non-alcoholic drink during warm weather, Lime Juice is steadily growing in favour. The Montserrat Lime Juice is also employed as the basis of a popular sauce made by the Firm. This sauce is claimed to be cheaper and more dietetic than any other condiment for the table. John Woodall, Master in Surgery, quaintly wrote, as far back as 1617, in a Treatise on Scurvy:—"I dare not write how good a Sauce it (Lime Juice) is at meat, least the Chiefe in the Ships waste it in the great Cabins."

Mr. Alfred Smith, Excelsior Works, Clayton, near Manchester.

IT would be an interesting study to try and calculate the extent of the increase of manufacturing industries that we may fairly expect to occur in the neighbourhood of Manchester during the next fifty years, taking for a basis the phenomenal progress that has been made since the Queen acceded to the throne. The prosperity and power of England have been built and maintained by the aid of her great industrial centres, the most important being, without doubt, Manchester, Sheffield, and Birmingham. For many years past Manchester especially has been noted for the energy and wealth of its manufacturers. During the past twenty years, a wonderful change has occurred in this city with respect to its size and influence. So great has been the enterprise of Manchester men, that it is well-nigh impossible to find any part of the civilised world with whose people they are not in touch through the medium of active representatives. In the Industrial Exhibition which the manufacturers and merchants of Manchester have so successfully promoted to celebrate the Jubilee Year, they have amply demonstrated the important part they play as factors in the great federation of that Empire upon which the sun never sets; and if the trade and commerce of the city and district continue to progress at the same rate as they have hitherto done, the Sovereign may well have reason to be proud of Manchester as one of the most important industrial centres in her dominions.

The Firm of Alfred Smith, of Excelsior Works, Clayton, Manchester, has, in common with other well-known houses in the neighbourhood, progressed rapidly during the past thirty years. The business carried on is principally in connexion with drysaltery, and has been prosecuted with much energy. The Works were established by Mr. George Smith, whose portrait accompanies this sketch, and were ably conducted by him up to the time of his retirement, three years ago, when the reins of management were taken in hand by his son, Mr. Alfred Smith, the present proprietor, under whose control the turnover has been doubled during the past year, and is now improving at a corresponding rate. It may not be out of place, therefore, to glance briefly at the specialties which are produced at the Excelsior Works. The most important point which has occupied the attention of the Firm for a number of years past has been how to cope with the incrustation and corrosion of steam boilers. Every engineer knows that these are caused by solids, consisting of salts and other organic and fatty matters, which are derived from the water used for raising steam; and if this evil is not speedily dealt with, a "scale," or "crust," is formed, which tends to destroy the boiler by the burning of its plates where the solid deposit has formed upon their inner surface. The "Excelsior Boiler Composition," which has been a specialty of the Firm for a number of years, is said to be a most certain preventive of the danger arising from this deposit. A strong proof of its excellence is that a great many imitations of it have been introduced, but they have not reached a tithe of its sale. It may be used wherever the necessity for machinery exists, and agents for its sale are to be found in various parts of the world. The demand for it increases every year, as fresh instances of its value are brought to light. It is compounded

upon scientific principles, so as to be adapted to neutralise the difficulties connected with the impregnation of all sorts of water, and to be suitable for every description of land and marine boilers. The plant of the Excelsior Works is capable of manufacturing upwards of two hundred tons per month, which, having regard to the nature of the article, may be considered an exceedingly large quantity.

Another specialty of the Firm is a Transparent Varnish, for the prevention of rust and oxidation of polished iron and steel work. Exporters of machinery often suffer loss through rust, caused by contact of goods with sea-water during a voyage. The varnish is claimed to give protection to all parts of machinery which are liable to damage in this manner. It dries quickly, and perfectly hard; will not rub off, and is unaffected by climatic changes. The chemicals required by india-rubber manufacturers are also prepared at the Excelsior Works; and, by means of a specially improved plant, an exceptionally superior quality of Bi-Sulphide of Carbon is made for commercial purposes. Mr. Smith contemplates a still further improvement in this manufacture. The poisonous vapours given off by Bi-Sulphide of Carbon have hitherto been a source of danger to life, but he is about to add new machinery for the production of an article which will be entirely free from smell. Another specialty is the "Eclipse Belting-Fluid," which is of value to manufacturers, mill-owners, and, in fact, to all who use steam-power where belt-driving is a necessity. Owing to the high tempera-ture of the rooms in which belts are generally worked, they are apt to dry and shrink. As a natural con-sequence, they often slip off the wheels to which they are attached—thus involving a loss of time and power. By the use of the Fluid, it is contended that this mishap cannot occur; and the belt may even be worked slacker than usual, so as to reduce wear and tear. For all kinds of heavy turning machinery the Fluid is largely in demand, and is calculated to accelerate the driving-power by twenty-five per cent. The distinction is claimed by the Firm of being the largest makers of Chloride of Sulphur, for vulcanising India-Rubber textures.

MR. GEORGE SMITH.

With the rapid in-crease of business, it has become necessary to open a branch Works for that section of the trade representing oil, grease, and varnish, and up-wards of three hundred tons of these goods are kept on hand. A substitute for foreign Asphaltum is also made here, which is admitted by competent judges to be quite as suitable for the manufacture of varnish as the imported article. Not-withstanding the prejudice of our manufacturers in favour of home productions, foreign Asphaltum has, until recently, held the market for this particular purpose; but Mr. Smith is confident that British Asphaltum will eventually monopolise the trade, and the energy of his Firm has probably brought this event within a measurable distance of consummation. Disinfectants, both in fluid and powder, are also manufactured at the Excelsior Works, and they command an extensive sale, especially for export. Other branches of business have also contributed to the growth of the Firm; but as it is not the object of this article to wander too far into the dry fields of detail, it will be sufficient to say that the various descriptions of work are ably carried forward.

It must have been a satisfaction to the founder of this Firm, during the closing portion of his career, to reflect that he would leave to his son and successor in the business that which is of far greater value than either power or wealth—the example of an industrious and practical life. The work he so well began and enlarged is being continued by Mr. Alfred Smith, with equal determination of purpose; and there is little reason to doubt that before many more years have run their course, the extent and prosperity of the Excelsior Works will have been still further developed.

Messrs. Hardman, Powell, & Co., Birmingham.

NATURE, it has been long recognised, has a style of form and detail peculiar and appropriate to every material in which she works. One material in her productions never looks like another. Rocks have their rugged outlines; minerals their appropriate crystals; metals their colours and glittering aspects; flowers their delicacy, and timber has its bark and cellular sections. Each product is distinguished by well-defined characteristics, and there is thus uniform consistency throughout all Nature's works. Simple as appears to us nowadays the lesson which these examples are intended to teach, it is an indisputable fact that until the time of Her Majesty's accession our manufacturers had not grasped this truth. In metal-working especially the best traditions of handicraft had been lost, and the productions of that time, whether in brass or iron, were of a most commonplace type. When this industry had reached its lowest depth there came, however, upon the scene two men who were destined to initiate a widespreading reform, and to leave their mark upon that and future ages—we refer to Augustus Welby Pugin and John Hardman.

The revival of the Gothic style of architecture through the instrumentality of Pugin has become a matter of history. His ideas would, however, probably never have been embodied in the practical and graceful form which they were made to assume, had it not been for the manner in which his projects were seconded and his plans carried out by the late Mr. John Hardman, whose portrait is shown on the next page. That gentleman was an enthusiast in all that concerned art industry; he threw himself heart and soul into the new project.

Sound practice, based upon sound principles, was the basis of the work then inaugurated. Every detail connected with the subject received critical attention; and neither time, labour, nor money was spared to insure the highest excellence in every single article that was produced. The traditions of the ancient craftsmen were revived, and the productions of John Hardman's workshops, as regards design no less than execution, were worthy to take rank with the greatest works of the best periods of Art. Upon the foundations thus laid, there has been built up a business which now, as then, stands foremost in connexion with the production of art work applied to ecclesiastical purposes. At the present time, as in days of yore, hand work is still the rule, and each article produced bears the impress of the mind which conceived it, and of the manipulative skill of him who gave it form and shape. Broadly speaking, the mechanical processes by which the class of work under notice is produced do not differ materially, in some of their earlier stages, from those ordinarily adopted in metal-working. The metal being first forged into bars or plates of the required size, is then worked by the hammer into the desired form; the decorations,—all, so to speak, the natural outcome of the construction,—are then added to the essential and purely useful part of the object. It is in the various methods of ornamentation that the true principles of Art are especially brought into play. Instead of monotonous repetition, there is constant thoughtful variety. The principle of Nature of varying form and detail according to the material employed, as referred to in the opening sentences of this article, is here resolutely kept in view. Beating, casting, hammering, &c., are

each resorted to according to the exigencies of the metal employed. The processes of embellishment pressed into service are still more varied, and include, amongst others, damascening, niello work, enamelling, engraving, repoussé work, saw-piercing, gilding, and filigree work. Much care and thought are expended in order to insure appropriate form, harmonious decoration, and perfect workmanship.

It is very interesting to watch the various processes of metal-working as carried on at the King Edward's Works, King Edward's Road, Birmingham, and to see the crude metal converted by the aid of subtle brains and lissom fingers into the most graceful shapes and forms, such as gas standards, candle and lamp fittings, coronæ, brackets, lecterns, gates, railings, finials, hinges, locks, &c. Independently of the above, high-class metal-work for domestic purposes is also made by the Firm under notice. As one examines typical examples of the various classes of goods, the conviction forces itself upon the beholder that, while we can

THE LATE MR. JOHN HARDMAN.

produce work of such high standard as this, there is no fear of our leading art metal-workers losing the proud position of pre-eminence which they have gained for themselves.

Under the present partnership the best traditions of the past are being worthily perpetuated, and the Firm's reputation has extended, and is still spreading in ever-widening circles. As bearing upon this latter point, let us mention a few of the more important works which have been carried out in this establishment, and this enumeration will speak more in their praise than could any words of ours. The Firm have supplied artistic metal-work, under the direction of the late Sir Charles Barry, Sir Gilbert Scott, and other eminent architects, for the Houses of Parliament, Alton Towers, Lismore Castle, Chirk Castle, Ely Cathedral, Magdalene College, Oxford; Eton College Chapel; St. Barnabas Church, Pimlico; All Souls' Church, Halifax; Frome and Selwood Churches; St. Martin's, Birmingham; Lichfield and Worcester Cathedrals; Berry Hall, Solihull; and the croziers for the Archbishop of Canterbury and for the Bishop of Toronto, and others. We might go on extending this enumeration considerably, but refrain; the list, as it stands, is a record of important artistic work, well planned and skilfully carried out, such as, probably, no other Firm can produce.

Messrs. John Hardman & Co., Birmingham.

STRANGE as it may appear to us at the present time, it is nevertheless a fact that of old the Catechism used in some of the dioceses of France instructed the congregation to look during divine service at the windows of the churches, as furnishing food for thought. Stained glass windows were at that time rightly regarded as a book which might be profitably studied by the laity. Those days in which the glass painter's art had been developed to its greatest perfection were, however, followed by a period of retrogression and decadence, when this, like many other industries, became almost a lost art, when in this country, at least, few stained windows were produced that could aspire even to the rank of mediocrity; so that by degrees it came to be thought that painted glass, except of the most common-place, could only be obtained of some of the then famous Continental makers.

About a century ago the art was revived in Birmingham—that most cosmopolitan of English cities, which has set us a worthy example in many other things beside this. The work turned out was, however, of a very poor description, and set at naught all the traditions and principles of the Mediæval glass-worker. Thus things continued in a sleepy, spiritless manner until A. W. Pugin made his influence felt here, as in other directions. His friendship with Mr. John Hardman has been already alluded to in the previous article, as also their joint influence upon the revived art of metal-working. With that far-sighted wisdom which formed so marked a characteristic of his nature, Mr. Hardman soon recognised that if stained glass was again to occupy the proud position in church architecture which it had held in the past, it was essential to establish studios in which such work should be cultivated. This plan was soon carried out, and upon the foundations thus laid there has since been built up a business which, while in the sense above indicated the earliest, ranks also amongst the foremost of its kind in this country. Originally carried on in conjunction with the metal-working branch already described on the two preceding pages, the business continued to develop so rapidly that Mr. Hardman soon after found it necessary to extend his operations, and consequently removed the Stained Glass Studios to Newhall Hill, Birmingham, where they are still carried on under the title of John Hardman & Co.

In these Studios the best traditions of the past have been revived. The primary requirements of stained glass, as understood by the old glass painters, are kept steadily in view. The windows here produced are not independent pictures, but are so designed and finished as to form part of the architectural whole of the buildings for which they are destined. The rules of glass painting, as distinct from pictorial art, are strictly followed, and the work produced is of a decidedly artistic nature.

Broadly speaking, the routine adopted is generally as follows. After the shape and situation of the window have been ascertained, an outline, drawn to a small scale, is prepared, and duly coloured in order to be submitted to the client. From this, if approved, the full-sized cartoon is drawn, the leads being all marked in black colour. A tracing having been made from the cartoon, is passed on to

the cutter, who places it on the table, puts the glass over it, and is thus enabled to follow with his diamond the lines of the original, varying the colour of the glass as indicated on the sketch. In the case of dark-coloured glass pouncing is resorted to for guidance in cutting. The window, as then formed, consists of an infinite number of pieces of pot metal and coated glass. Pot-metal is so called from its being coloured with oxides of metals fused with the glass in the furnace, while coated glass is merely white glass covered on one side with a layer of pot-metal. The reason for this in the case of ruby is that its colouring is so intense that it would seem opaque if formed into a sheet of ordinary thickness. Ruby, we may add, is one of the most powerful colours, and is largely brought into requisition for draperies, allowing as it does of beautiful variations. After this the glass is painted upon for the purpose of giving expression to the features, &c., and the general effect of the original is brought out by the aid of opaque lines, brown shades, and yellow stains. The separate pieces of glass are then taken to the furnace to be fired.

Next in order comes the "leading." The tracing of the outline before mentioned is laid upon the table, and, guided by this, each separate piece of glass is fitted into its place. The joints of the lead are ultimately soldered, and then the window is ready to be fixed to its iron framework. The leading just referred to, although simple in itself, forms one of the great obstacles with which the artist has to contend. Much skill is shown by the Firm in managing the leadwork, so as to make it form a natural and integral part of each window, instead of breaking up the symmetry of the design.

All the various processes which we have here briefly outlined, and many others, we witnessed on the occasion of our visit to Newhall Hill. In one room after another through which we passed a large staff of artists were busily engaged in the various operations alluded to, and we were struck with the feeling of calm and repose prevailing everywhere, and the absence of all hurry and drive.

As evidence of the freshness and originality which are cultivated here, we may mention that except for special reasons no design is ever duplicated, it being the Firm's laudable ambition to produce only work which shall bear the impress of original conception and of artistic execution. How well they have succeeded in this, the following list of some of the more important works carried out by them will attest:—Stained glass windows in the Houses of Parliament; in Carlisle, Worcester, and Lincoln Cathedrals; in Magdalen College, Oxford; in the parish churches of Aston and St. Martin's, Birmingham; St. George's and St. Mary's, Beckenham (Kent), Newbury (Berks); in the Chamber of Commerce, Dundee; in the University of Aberdeen, &c., have all been supplied by them.

On the occasion of our visit we were also greatly impressed with the happy and cordial relationship which exists between the Firm and their staff, partaking apparently more of a family character than of anything else. Most of the employés have grown up here from boyhood, and have spent their whole lifetime, even to old age, with the Firm. Indeed the late Mr. Hardman and his partners long ago acquired a reputation for discerning talent and fostering it; and their Glass Studios no less than their Metal Works have proved in their respective branches, great Industrial Schools, in which have graduated many who have since taken foremost rank as artists and mechanics in connexion with the designing and production of Stained Glass, and of Metal Work.

Messrs. R. E. Crompton & Co., Chelmsford.

ALTHOUGH the Electric Light has been invented more than half a century, it is only during the last decade that its production on a commercial scale has become one of the prominently important industries of the day. Previously to the year 1878, with the sole exception of Mr. J. Wilde, of Manchester, no English manufacturer had thought it worth while to look for himself into the enormous possibilities which the production of large currents of electricity, generated directly from the mechanical energy of the steam-engine, promised to metallurgists, chemists, lighting, and mechanical engineers.

Amongst those who visited the Paris Exhibition of 1878 was Mr. Crompton, of Chelmsford, in Essex, who then made the acquaintance of Mr. Gramme, and brought back with him to England a pair of the famous French electrician's dynamo machines. Mr. Crompton shortly after this commenced the manufacture of these or similar machines at Chelmsford, and the Works then started grew so rapidly, that in eight years' time the firm of Crompton were employing 500 hands, and manufacturing and exporting to all parts of the world every requisite for electric lighting, electric transmission of power, and electro metallurgy. Mr. Crompton's aim throughout has been to improve upon all existing models in such a manner that the machines which the Firm at any time were manufacturing would be superior to all others, and he has thus succeeded in gaining the highest awards that have been given at all the great Exhibitions of electrical apparatus which have been held since the year 1878.

Before describing Messrs. Crompton's Works, we propose to give our readers a general idea of the nature of the machinery used to produce the electric light.

Electricity is generated by dynamo machines, which play the same part of forcing a current of it through the conductors or electric mains as a water company's pumping-engine does in forcing the water through the water-mains into our houses; in fact, the dynamo machine might well be called an electric force-pump. Electricity is utilised for lighting purposes, either by arc lamps, which are used for lighting large spaces, or incandescent (sometimes called glow lamps), for lighting our own houses. Without making our description too technical, we may say that dynamo machines generate currents of electricity by causing coils of copper wire to pass rapidly through an intense magnetic field; in other words, to pass between, and in close proximity to, the poles of powerful magnets. This has the effect of causing a current to be set up in these coils. From them it is collected and sent out, through insulated conductors, to the lamps, or wherever it is to be utilised. The general description we now give of a dynamo machine, as made by Messrs. Crompton, would apply, with few modifications, to those made by most of the other makers. These machines always consist of two principal parts—1st, the magnets, which form a fixed massive framework, and between the poles of which the intense magnetic field is produced; and 2nd, the armature or revolving part, which carries the coils of wire in which the electricity is generated. The magnets themselves in Messrs. Crompton's machine take the

form of a rectangular framework of wrought iron, which may be considered as two massive horse-shoe magnets placed pole to pole. In some of the machines made by Messrs. Crompton and by other makers the framework takes the form of a single horse-shoe magnet, but in both cases the poles are made to approach each other, and are bored out so as to make a cylindrical cavity or tunnel within which the armature, which is also of cylindrical form, can revolve. The magnets are electro magnets—that is to say, they only develop their magnetic field when a current of electricity is traversing the coils of copper wire which are wound on to them. At the time when the machine is standing, and no current is being generated in its armature, the magnets are inert masses of iron, and show little or no trace of magnetism. The armature of these machines consists of a cylinder of soft iron, made of discs of thin sheet iron, threaded on to a central spindle; over this cylinder, which is called the core, are wound a number of coils of copper wire in a direction parallel to the axis or spindle. The number of these coils is sufficient to cover the whole of the external surface of the core; the sketch shows the general appearance of such an armature. The smaller part of the cylinder at the left hand is called the collector or commutator. It is here that the current generated in the armature coils is collected by a pair of brushes, which rub lightly on this part of the armature as it revolves. The bearings carrying the armature are placed, as is shown in the sketch, so that it can revolve in the cavity or tunnel bored out to receive it between the poles of the magnets, as above described. It is driven by a belt on the pulley, shown on the right hand, and, as it revolves, the wires wound on to it are forced in succession through the strong magnetic field on the magnets, and the current so generated in them is collected by the brushes pressing on the collector, and which can be seen above and below it, close to the bearing. These brushes are elastic combs, made of several thicknesses of copper sheet; from the brushes about 95 per cent. of the current passes away direct to the conductors; but from 3 per cent. to 5 per cent. is diverted through the magnet coils for the purpose of exciting the electro magnets, so as to produce the strong magnetic field required in them.

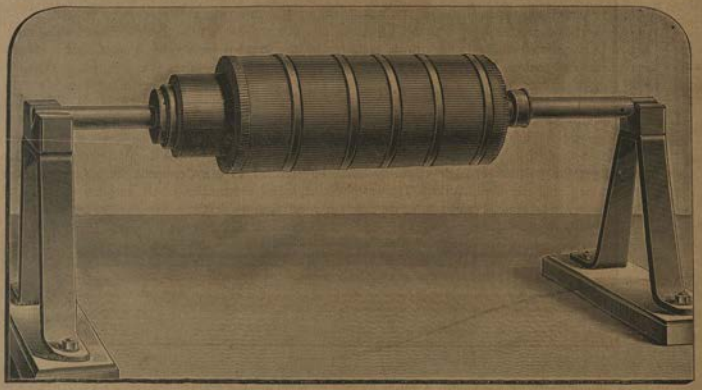
Although, as we have said before, this general description of a dynamo machine would apply to many others besides those made by Messrs. Crompton, a very large share of the various improvements which have brought it to its present position of high efficiency must be credited to Mr. Crompton himself and to those working with him at the Chelmsford Works. The massive mechanical construction of the magnets and armature, the use of the softest and purest wrought iron, and the mode by which the severe mechanical strains are transmitted from the driving spindle to the revolving coils, were all first introduced by the Chelmsford Firm, after long and costly experiments; and Mr. Crompton's practice has been widely followed by other makers.

Space forbids our describing the various kinds of arc lamps which are employed for holding the carbon rods, between the points of which the electric arc light is developed; and the same may be said of the electric incandescent or glow lamps. Briefly, the latter may be described as glass globes, from which the air is exhausted, and which contain a slender, hair-like filament of pure carbon. When the electricity passes through this filament it heats it, and thus raises it to a degree of incandescence sufficient to give off the required light but without causing it to burn away; so that these lamps have been known to last 9,000 hours, although the average life is very considerably less than this.

The Arc Works at Chelmsford cover a space of about three acres, on which have been erected buildings sufficient to accommodate 600 workmen. On the ground-floor of the main building are placed the principal machines—lathes, planing, slotting, milling, and drilling machines usually found in engineering shops, and which are employed in preparing and shaping the various portions of the electro-magnets and bed-plates of the dynamos and other heavy machinery. The second floor is used for the construction of the armatures, and for parts of the electric lamps and other apparatus used in fitting up houses and factories. On the third floor are carried on the lighter operations—manufacture of instruments of precision and experimental apparatus. Adjacent to the ground-floor is placed the test-room, whence electric wires lead to every part of the establishment at which it is necessary to conduct an electric test. The test-room contains the various instruments used in carrying out the above tests; a photometer-room for measuring the light given by every kind of electric lamp; also elaborate apparatus for finally testing the dynamo machines, when they are complete and ready for dispatch to their various destinations. A complete record is entered into the books kept in this test-room of every machine, and part of machine, manufactured in these Works. Messrs. Crompton have, therefore, a history of every machine that has left their Works since they commenced in 1879.

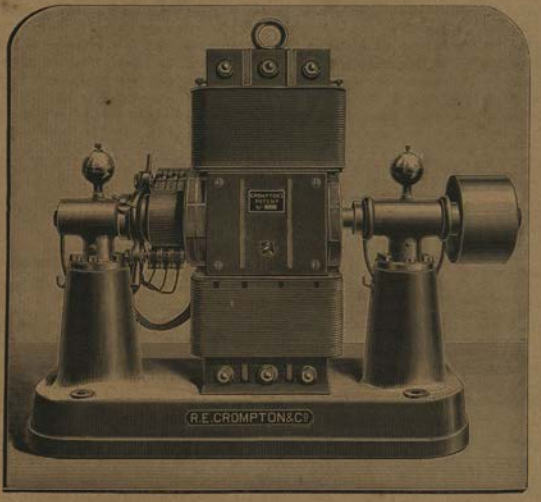
Amongst the earliest work undertaken by this Firm was the introduction of the electric light into the Royal Courts of Justice, and into many of the largest railway stations in the kingdom. They have also supplied the machinery for Buckingham Palace, Cardiff Castle, Wentworth, and a long list of country mansions. For

naval and military purposes they have supplied machinery for a large number of Her Majesty's ships, for lighting Woolwich Arsenal, the new Docks at Tilbury, and the Royal Small-arms Factory at Enfield. They have also been successful in applying electricity as a means of working the heavy guns now used for our land defences, so that instead of needing a gun's crew of thirty men to run out, elevate, and fire a 100-ton gun, whether fixed in casemates or in turrets, the whole of these operations can be carried out by two or three men, supplemented by their willing slave, the electric current—every operation being performed by the touch of a finger, and with the utmost speed and smoothness of action. The unfortunate manner in which the Electric Lighting Act of 1882 has tended to cripple the trade of "house-to-house electric lighting in England," has forced Messrs. Crompton to find the major field for their labours abroad, and they have now for some time been engaged as contractors for the Imperial Continental Gas Association (for whom Mons. D. Monnier, of Paris, is Consulting Engineer), in carrying on elaborate works for lighting the two largest imperial theatres in Vienna. The arrangements of the lighting of these theatres is to be singularly complete. In addition to the ordinary lighting of the auditorium, the lighting of the stage and scenery will be controlled in a manner altogether



novel. The lights throughout will be in triplicate—white, blue, and red—and the arrangements are such that one person, sitting in front of a small keyboard somewhat like that of a pianoforte, can gradually lighten or darken any portion of the stage with any of the above coloured lights, or can use any combination of them, or can pass gradually from one shade to the other, and thus produce effects of artificial lighting which would have been perfectly impossible with gas, or any means hitherto known to theatrical machinists. Quite lately the energies of the Firm have been directed to the production of dynamo machines of colossal proportion. These are to be used for metallurgical purposes for smelting highly refractory substances, such as the ores of aluminium, in the electrical furnaces invented by Mr. Eugene Cowles, of Cleveland, U.S.A. The machine they have now in hand for this purpose is more than twice the size of any dynamo machine hitherto constructed in the world. It is believed that the introduction of these enormous dynamo machines will result in producing aluminium at such a low rate that this beautiful light and white metal will become almost as cheap as copper, and will, in many ways, revolutionise engineering construction. The order for the colossal dynamo above referred to was obtained by Messrs. Crompton in full competition with the whole of the dynamo makers in the world, including those in Europe and America; and it speaks well for the old Chelmsford Firm that it should have succeeded in winning the high honour of being entrusted with this very special work.

For a long time Messrs. Crompton have taken and trained pupils in the profession of Electrical Engineering, from whose ranks several of the most prominent of the practical engineers of the day have been recruited. For some considerable time after 1878, Messrs. Crompton continued to be the only English Firm engaged in the production of the heavier classes of electrical machinery; but the outburst of speculation in 1881 which followed Edison's announcement that he had subdivided the electric light, and which caused a terrible scare amongst the



owners of gas shares, brought into the field a large number of companies, comparatively few of which have ever founded Works, and, as a consequence, they have, with few exceptions, ceased to exist. During this feverish period Messrs. Crompton contented themselves with filling their Works by executing orders for the various companies, and by acting as contractors for them. By this wise and modest policy they were able to make a steady advance and secure a position, connexion, and reputation for high-class work, and they were able to weather the storm which wrecked almost all their electrical competitors. Now that the industry is entering into a more healthy stage, the oldest Firm still continue to enjoy the advantages of the older connexion.

Messrs. Greenwood & Batley, Leeds.

SCIENTIFIC knowledge and practical skill are nowhere brought into greater requirement than in connexion with engineering and machine construction. Uniformity and delicacy of motion, together with high velocity of rotation, are among the essentials of modern steam-tools, and the progressive developments of recent years have worked a marvellous revolution in every branch of manufacturing industry. Well-nigh endless are the applications of machinery to modern requirements. It is pressed into service for such diverse purposes as the manufacture of munitions of war, for spinning and weaving, for converting corn into flour, for pressing oil from the olive, for the working of metal and wood, for the manufacture of steam engines, for the building of printing-presses, &c. Greatly varying in their character and differing in their purpose as are the machines just enumerated, the whole range of these, as well as many other types of tools, are made by the Firm whose productions will engage our attention in the present article.

The business of Messrs. Greenwood & Batley, of the Albion Works, Leeds, was established by Mr. Thomas Greenwood, whose father had been long known as a manufacturer of machinery used in the woollen trade. In 1830 Mr. Greenwood, in conjunction with his brother, commenced the making of machinery. This enterprise was not of long duration, in consequence of the brother's death. Afterwards Mr. Greenwood was entrusted by Sir Peter Fairbairn with the management of the Wellington Foundry, and in 1848 both he and Mr. Batley were taken in partnership. Under their joint co-operation the business of Fairbairn & Co. was greatly expanded, and Mr. Greenwood designed and introduced many new and ingenious labour-saving appliances. In 1856 the two gentlemen whose names head this article retired from the above partnership, and started on their own account, laying the foundation of a business that in its own particular line stands to-day without a rival. A few years ago Mr. Thomas Greenwood died, while Mr. Batley has for some time past retired from active participation in the business. The present managing partners are Mr. George and Mr. Arthur Greenwood, the sons, and Mr. Henry Greenwood and Mr. J. H. Wurtzburg, the nephew and son-in-law respectively of the founder. Under their joint administration the concern has continued to grow and the strides which have been made in the introduction of new kinds of machines for a variety of purposes and in the improvement of old types are truly marvellous; and it will be our object in the following notes to point out the many-sidedness of the business itself and the unparalleled perfection to which the various machine-tools here produced have been brought.

First as to the Albion Works themselves. They are of very large extent, covering altogether some eleven acres of land, with a frontage to Armley Road, and having at the back a commodious wharfage on the Leeds and Liverpool Canal. The Works comprise two iron foundries, measuring respectively 48 ft. by 146 ft. and 49 ft. by 66 ft., fitted up with cupolas and steam cranes capable of turning out castings of 15 tons weight,

and actually producing from 50 to 60 tons of castings per week. These latter figures imply more than is apparent at first glance; the castings being for the most part of a light and intricate nature, the weekly output of machinery, &c., is much larger than is indicated by the above total. Adjoining the foundry is a large three-storeyed building, 48 ft. by 112 ft., set apart as a pattern store. Next we come to two large machine and erecting shops, built in the form of a T, the larger portion having a width of 72 ft. and a depth of 464 ft., and the shorter portion being 76 ft. by 168 ft.; both having two storeys. The power to these shops is supplied by two horizontal condensing engines of about 100 horse-power each, while a considerable number of independent steam-engines are to be found in different parts of the Works. A long range of buildings extending from the rear of the Foundry towards the canal is used specially as a factory for the production of torpedoes, and terminates at the canal side in a splendid erecting shop, 226 ft. long by 55 ft. wide, for the very largest class of tools. Parallel to this are in succession an iron warehouse; house with kitchens, large dining-room and museum; joiners' and casemakers' shops; and a large shed, 94 ft. long by 88 ft. wide, just erected for increasing the torpedo department and for stores. Another two-storeyed machine shop fronts Armley Road, and measures 22 ft. by 128 ft.; while in the centre of the quadrangle there is a further building of two storeys (68 ft. by 68 ft.), the lower one being used as a machine shop, and the upper one as a drawing office and pattern-maker's shop. In addition to the above there is a long range of smiths' shops, containing some thirty fires, and fitted up with steam hammers and forging machinery generally. There are a number of other shops set apart respectively as a brass and malleable iron-foundry, a second forge, carpenter's shop,

FIG. 1. HORSFALL'S PATENT BOLT AND NUT FORGING MACHINE.

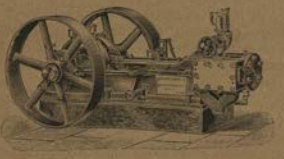


FIG. 2. THE ARMINGTON-SIMS PATENT ENGINE.

FIG. 3. "SUN" PLATEN PRINTING MACHINE.

warehouses, &c., all planned on a correspondingly large scale, and fitted up with every kind of labour-saving appliance. The commodious counting-house and the private offices of the partners also abut on Armley Road; and these, like all the workshops throughout, are light and airy; and what must further add to the comfort and health of the employés is that the electric light is fitted up in every department. When we come to speak of the Firm's productions, we confess ourselves altogether nonplussed. The variety of machines is so great, and they are withal of so complex a character, that to describe any one of them fully would almost occupy the whole of the space at our disposal for this complete article. We shall, therefore, have to content ourselves with generalities, and only mention briefly a few of the leading types. In order, however, to follow some method in our remarks, it may be well to divide the machinery here made into, say, half a dozen classes, and to deal with each one separately.

From the time when the Works were first opened, the Firm have paid special attention to everything connected with "Munitions of War," and in this branch they continue even to this day to hold the very foremost position. Many special types of machines have been invented by them, and they have supplied the most important plant, embodying the latest improvements, to the British War and Naval Departments; to the Indian, and to all the principal foreign Governments. The very mention of this fact fully establishes that in this particular line Messrs. Greenwood & Batley stand altogether unrivalled. Their productions under this head include machines for the manufacture of small arms of all kinds, including gun-stock machinery, and for every operation in rolling, forging, and completing rifle and pistol barrels, breech actions, and bayonets, with the necessary fixtures, cutters, and gauges. Other machines are made for the manufacture of cartridges of all descriptions, of bullets, percussion caps, and of Common, Shrapnel, Chilled, and Steel shot and shell. Of a cognate nature are the machines of the very latest system for the manufacture of rifled ordnance, up to the

very largest sizes, and for gun carriages and platforms for same. Similarly they produce plant for making military rockets, brass and wood fuses of all patterns, and machinery for the manufacture of gunpowder, gun-cotton, and a whole host of other articles of a similar nature. Machines for the manufacture of torpedoes are also made here, besides which the Firm themselves produce torpedoes in large quantities for the British Admiralty, they being, we believe, the only private Firm who enjoy this privilege.

Without having anything like exhausted the list under the above caption, we must pass on to the next division. This comprises all kinds of engineers' general and special tools for a great variety of purposes, and include a large number of patent machines, such as for screw, bolt, nut, rivet, and railway spike making and finishing; for automatic and ordinary screw making; for wheel cutting and dividing; for horizontal boring and radial drilling, &c. In addition to these the Firm make patent drop hammers, atmospheric hammers, Ryder's forging machines; patent Universal and other milling machines for all classes of work; endless band-saws for cutting cold iron and steel, and circular saws for iron and steel, whether hot or cold. To this category belong further lathes, planing, slotting, shaping, drilling, punching, and trimming machines; wood-working and cask-making plant; patent capstan rest lathes, and other tools specially adapted for brass finishing; yet a distinct variety comprises rock drills, air compressors, and mining machinery.

Limits of space preclude us from selecting more than one illustration as representative of the many

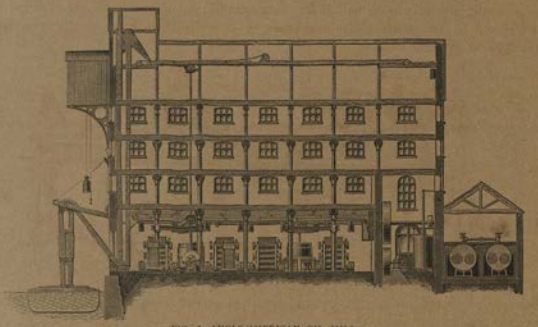


FIG. 4. ANGLO-AMERICAN OIL MILL.

types of machines comprised in this class. Fig. 1, on the preceding page, illustrates one of Horsfall's Patent Bolt and Nut Forging Machines. By the aid of this ingenious tool heads of any desired form can be formed on bolts, screws, spikes, or rivets. The best class of nuts, both square and hexagon, can also be thus formed. No skilled labour is necessary, and from twelve to eighteen gross of bolts can be produced by one machine per day. With all these points in its favour no wonder that it is in large demand both in this country and abroad.

Next in importance comes the manufacture of oil-mill and flour-mill machinery. In these two branches, the last decade or two has witnessed gigantic strides of progress. As regards oil-mills, Messrs. Greenwood & Batley supply not only the various implements and accessories in general use, but they make a specialty of manufacturing complete oil-mill plant. One of these, fitted up in the most economic style as to working, on what is known as the Anglo-American system and supplied with the most improved machinery, is illustrated in Fig. 4. This mill is adapted for crushing 400 tons of seed per week, and is capable of treating every kind from linseed up to palm kernels. It would take us too far to describe in detail the various processes by which the different seeds are converted into oil. The perfect working of these oil-mills, the high quality of the oil and cake produced by them, and their large productive capacity are sufficiently attested by the large number supplied by the Firm to seed crushers in the United Kingdom as

well as in the Colonies and foreign countries. Another type of oil-mill appropriately termed the "Economic," contrived on the same improved system, is specially built for export.

Flour-milling is a cognate branch of industry to which Messrs. Greenwood & Batley have devoted considerable attention, and in connexion with which they have introduced many important improvements. By special arrangement with Mr. J. A. A. Buchholz, the patentee, the Firm are now manufacturing his improved Belt Roller Mills. These are highly effective and economical in working, and produce a better quality of flour. These patent Roller Mills, which have been further improved by the makers, are now being largely substituted for the millstone, in many of the largest flour-mills in the kingdom, and the milling fraternity has been laid under great obligation to the Firm by this highly ingenious improvement.

Yet another department of the business is devoted to the manufacture of Textile machinery. In this class, again, are included many patented appliances, including machines for preparing, combing, dressing, spinning, twisting, and reeling silk waste, china grass, wool, and other similar fibres. In this connexion mention may be made of the strip cutting, rolling, and other machinery for leather belt making and leather working. Highly ingenious, again, are the cloth-cutting machines, which, not unlike band-saws in appearance, enable a large number of articles of clothing to be cut to a uniform pattern in almost less time than it takes to pen this. Their value to wholesale clothiers and army contractors is thus self-evident. As to the prestige which this class of machinery enjoys, no one who has, like the present writer, passed through a large number of textile manufactories, but must have noticed, again and again, the legend "Greenwood & Batley, Leeds," affixed to the machine—an inscription, be it added, that is universally recognised as a voucher of strength, quality, and working capacity.

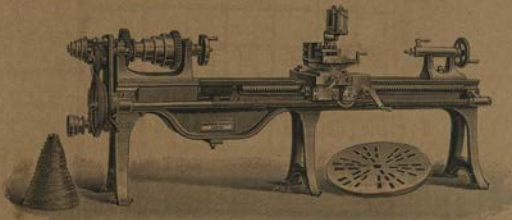


FIG. 3. SELF-ACTING SLIDE-SURFACE AND SCREW-CUTTING LATHE.

Probably, in equal importance to any of the foregoing branches is the one which next engages our attention, viz., the manufacture of steam-engines. A specialty in this branch is the "Armington-Sims Patent Steam-Engine," being a marvellous advance upon every other kind of power-producing apparatus. From the illustration (Fig. 2) shown on the second page of the present notice, some idea will be gained of the compact nature of this engine. Without going into a description of its mechanism, we may say that among its special advantages are extreme simplicity, entire absence of parts requiring frequent adjustment, great regularity of speed, small cost, especially for great powers, and small space required for engine and fly-wheel. This engine is, moreover, compact in form, and possesses exceptional rigidity in all its parts. It is fitted with automatic cut-off regulator, which keeps the lead of slide-valve constant, and uses the steam expansively by cutting off steam in proportion to power used. These engines are made both condensing and non-condensing, and, having seen them in active operation, we can vouch for the smoothness and noiselessness of their working; while for steadiness, too, they are probably unrivalled. This latter point marks them out as specially adapted for dynamos and electric machinery, for which purpose they have been largely adopted both here and in the United States, with the most gratifying success, as is attested by the number of recent testimonials which have been addressed to the Firm by users.

As electrical engineers, Messrs. Greenwood & Batley have established a foremost reputation, and they make patent dynamo electric machines for lighting by arc or incandescence; for electro-deposition of metals, for charging secondary batteries, and for transmission of power.

Messrs. Mitchell Brothers, Waterfoot, near Manchester.

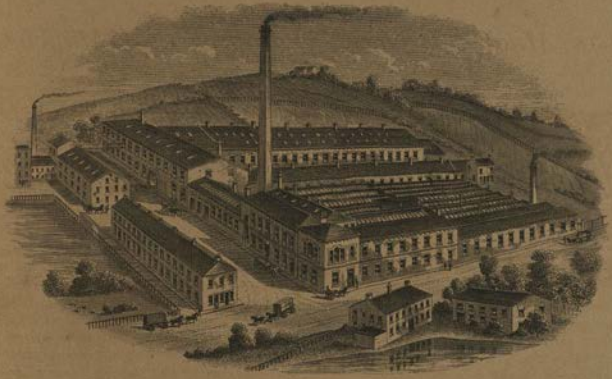
AMONG the many industries to which the unflagging spirit of commercial enterprise has given rise within the last three or four decades, there are few more interesting than that of the "Felted Carpet" Manufacture, though it is of comparatively modern growth. Many indubitable proofs exist that felted carpets are among the most ancient in the world. There is at the present time, still extant, a felted carpet which is known to be 1,500 years old. The fabric, which has been entirely felted by hand, is in a wonderful state of preservation—the colours and the strength of the carpet being absolutely unimpaired. To an ordinary observer it would appear to be printed, but a closer inspection reveals the interesting fact that the design has been obtained by felting, the colours being supplied by small tufts of dyed wool, which, having been correctly placed on the surface, were afterwards rubbed in by the hand until they were thoroughly incorporated into the fabric. This interesting relic affords satisfactory evidence that felted carpets of pure wool and first-class manufacture are unsurpassed for durability.

In its early history the production of felt and baize comprised three distinct and separate trades. The cloth was originally made in Leeds, but the subsequent processes of printing and dyeing were effected in Rossendale,—a district some twenty miles north of Manchester. The cost of carriage, bad water, and the delay in the transit of the goods constituted a serious drawback to the permanent success of the Leeds manufacturers, and the rapid expansion of the trade naturally led to the establishment of felt works in Rossendale. The idea had taken such a practical shape, that in the year 1867 five Firms were engaged in felt manufacturing in this district, producing in the aggregate about 1,000,000 yards per annum. Thus Rossendale contained within itself the various means of manufacturing, printing, and dyeing, the result being that the felt industry as rapidly declined in Leeds in proportion as it increased in Rossendale.

The necessity of concentrating the three businesses under one Firm had long been apparent, and in 1869 a company was formed for this purpose, under the style of "The Rossendale Printing, Dyeing, and Manufacturing Co., Limited," and a considerable capital was invested in the erection of premises, known as the Albert Works. Owing to insufficiency of capital, this Firm eventually suspended business, and the Albert Works, together with the printing and dyeing plants, were ultimately purchased in the year 1868 from the liquidators of the Company by the Firm of Messrs. Mitchell Brothers. Up to this time the Albert Works had been employed in printing and dyeing only, but since Messrs. Mitchell assumed ownership of the property there has been a continual and rapid extension of the premises, with the distinct purpose of combining the several trades of manufacturing, printing, and dyeing, and so ensuring promptness in the execution of orders and a great diminution in the cost of production.

In this sketch of the Felted Carpet Trade, we have selected the Firm of Messrs. Mitchell Brothers, not only because they stand at the head of this particular branch of manufacture, but because they afford the best

practical illustration of the progress which has been achieved in the important technicalities of colour and design. Their premises include Fountain Mill, Whitewell Mill, and Albert Works,—the latter having increased three-fold within the last twenty years. The whole of the buildings cover an area of over four acres of ground. The average annual production of cloth is 1,248,900 yards, which is nearly 25 per cent. in excess of what was produced in 1867 by the combined felt manufacturers of Rossendale. The Albert Works are built upon a site which was originally known as "Fountain," which derives its name from a celebrated spring famous for the softness and purity of its water. The Works are situated in the Whitewell Valley, which lies between and parallel with the Bacup Valley on the east and the Crawshaw Booth Valley on the west. In the Bacup Valley the Irwell Springs Printing and Dyeing Co. carry on their business of printing and dyeing, and in the Crawshaw Booth Valley the Rossendale Printing Co. are largely engaged in the printing of calicoes. These three valleys are separated from each other by ranges of lofty hills, which rise to a mean elevation of some 1,300 feet above the sea. The mountain streams collected on this elevated land flow through the



THE ALBERT WORKS.

Whitewell Valley, furnishing the Albert Works with a supply of water, which constitutes an incalculable advantage in the processes of printing and dyeing from its great clearness and softness.

Like most other trades, the Felted Carpet industry has suffered severely from excessive competition, and the quality and durability of the goods have been largely sacrificed, in obedience to the imperious necessities of nominal cheapness. With the view of preserving the character of their goods, Messrs. Mitchell Brothers have adopted trade marks, the most successful of which is the "Velveen Carpet," which is made from pure wool, and is produced in every variety of colour and design. They have also obtained Royal Letters Patent for their "Rockminster Carpet," pronounced by medical men to be a most desirable carpet, from a sanitary point of view, preventing those accumulations of dust, too often the active agents in the propagation of disease.

In addition to Felted Carpets, the Firm of Messrs. Mitchell Brothers are large producers of Underfelts, Baizes, Table Covers, Flushings for shoe linings and slippers, saddle cloths, Patent Felt for glass polishing, and many other varieties of felt. A great number of important improvements in machinery have been patented by the members of this Firm, all of which have been strictly confined to their own particular business, and are in operation in no other Works in England, and have been of inestimable service in producing superior productions. The Firm comprises three brothers,—Mr. William Mitchell, of Fern Hill, Stackstead; Lieutenant-Colonel Mitchell, who conducts the London branch; and Mr. J. C. Mitchell, of Springfield, Manchester.

Messrs. Rufford & Co., Stourbridge.

STOURBDRIGE FIRE-CLAY has a world-wide reputation, and its importance in the manufacture of fire-bricks, glass-house pots, and a variety of other purposes in connexion with the Industrial Arts need not be enlarged upon. Its chief value consists in its refractory character, which enables it to resist the highest temperatures without melting. As evidencing the importance of this industry, it may be stated that the quantity of clay raised in the Stourbridge district amounts to some 160,000 tons per annum, and the number of fire-bricks produced in a twelvemonth cannot be less than 40,000,000.

Foremost among the Firms that have helped to develop this industry is that of Messrs. Rufford & Co., Hungary Hill, Stourbridge, which was established early in the present century. There are virtually two branches of the business. What are as the New Works are devoted to the manufacture of glazed bricks and porcelain baths. Covering two acres of ground, and being nearly 1,000 feet long, these Works afford every facility for the expeditious and economical carrying on of the trade on a large scale. They have been specially planned to economise both time and labour throughout the manufacturing processes. The clay as well as the coal used are in the main mined in the Firm's own pits, whence, after the clay has been ground and tempered in the mills, it is brought to the Works by means of a tramway. The workshops proper are three in number, and measure 150 ft. by 30 ft. They are heated by underground flues, and the bricks having been moulded by hand, are placed on the floor to dry. When duly "set," the accurate shaping of the bricks is insured by screw presses, and after this they are treated with a special composition, which, on the subsequent application of the glaze, makes the latter adhere to, and form an integral part of, the bricks. Drying in frames and baking in the kiln complete the work.

There are altogether ten kilns constructed upon an improved principle, so contrived that the flame does not come in contact with the bricks during the firing, while at the same time the consumption of fuel is greatly lessened. This ingenious arrangement is the invention of Mr. Holcroft, the senior partner of the Firm, and is covered by patent rights. Each of these kilns will hold 12,000 bricks, and six out of the ten can be utilised for the firing of porcelain baths. Every provision is made throughout the Works to insure the best hygienic conditions for the workpeople; an elaborate system of flues, running underneath the whole of the buildings, carries off all the gases and vapours into a shaft 132 ft. high.

The manufacture of porcelain baths in one piece is a specialty of the Firm. At the suggestion of the late Prince Consort the Society of Arts in 1846 offered a premium for the production of such an article, and after protracted experiments, Messrs. Rufford & Co. succeeded in perfecting a porcelain glazed bath. The Jury of the 1851 Exhibition, in awarding the Gold "Isis" Medal to this Firm, spoke of the invention as "ingenious," and remarked upon its "novelty and cheapness." There is probably nothing to equal porcelain baths on sanitary grounds,

as they are easily kept clean, and the glazed surface allows no resting-place for infectious germs. These baths are now in universal demand for private houses as well as hospitals and other public institutions. Their manufacture forms a leading branch at these Works, and three spacious buildings, measuring each 300 ft. by 30 ft., are set apart for the purpose. They can be had with the outside painted in imitation oak or panelling, so as to require no surrounding wood or other fittings. Housemaid's and hospital sinks, and washing tubs, formed of the same material, are also largely produced; and for durability and cleanliness these as well as the baths are unrivalled.

Adjoining departments of the business include painting-shops, cement-grinding rooms, stores for clay, &c., and a commodious warehouse. In the last-named can be seen a representative collection of the various productions, including porcelain baths, sinks, troughs, fire-brick goods, and an excellent assortment of coloured glazed bricks, which are so largely used in modern architecture. From among the important public buildings for which they have been recently employed we may mention the Birmingham Art Gallery.

Bird's-eye View of the Works of

Messrs. Rufford & Co., Stourbridge.

Not far from the Works already noticed are the Upper Fire-Brick Works, near which are situated the fire-clay and coal-pits owned by the Firm, the whole covering an area of 150 acres. Powerful engines representing an aggregate of 250 horse-power are here employed in raising the raw materials from the pits, in grinding the clay, and in pumping. Blacksmith's and repairing shops, pattern-making, wheelwright's and other workshops and stores are provided, which help to make the Works self-contained. Every description of fire-brick is made here, and the utmost care is exercised throughout the various operations to insure the highest quality of material and the best finish. The great extent of this portion of the Works may be inferred from the fact that there are twenty moulding-stoves and nine burning-kilns. In addition to ordinary fire-bricks, the range of productions includes crucibles for brass casting, and clay gas-retorts of a special character, which have proved far more useful than those of the ordinary type.

Commodious offices and packing-rooms are attached to the Works. In the packing of baths, especially, great pains are taken to insure their safety during transit.

Before concluding our notice of this Firm, it is deserving of mention that from the beginning of their business, Messrs. Rufford & Co. have made it their special study to manufacture and supply only articles of the best quality. To this good precept they have conscientiously adhered during their whole commercial career; and they have thus built up a reputation in their own branch of trade second to that of no other house. By those connected with the trade, both at home and abroad, it is indeed acknowledged that the mere fact of any article having been made at these Works is in itself an ample voucher for excellence.

Messrs. H. Smethurst & Sons, Grimsby.

BOTH gastronomic and hygienic authorities are agreed that the "harvest of the sea" yields one of the most wholesome and valuable contributions to the national commissariat. The importance of fish as an article of food has been recognised from an early period, and this particular industry has been fostered in times past by kings and governments. It is, indeed, upon record that the Emperor Charles V. made a pilgrimage to the tomb of the man who discovered the method of curing herrings now in use. To realise how greatly this trade has been developed in recent times, one need but recall the fact that not more than some two generations ago a moderate-sized turbot cost from two to three guineas, and a lobster some twelve shillings, whereas now every kind of fish is placed upon the market in such quantities and at prices as to make it a necessary rather than a luxury, and bring it within the reach of all classes.

Grimsby, in Lincolnshire, ranks undoubtedly as the Fishing Metropolis of this country. Its growth and prosperity have progressed in the same ratio as has the fishing industry itself. A century ago it was a village of less than 1,000 inhabitants, whereas it ranks at the present time as an important seaport with a population of nearly 50,000 souls. As a Firm representative of the chief industry of the place we have singled out that of Messrs. H. Smethurst & Sons, who are not only prominent as wholesale fish salesmen, but own also a considerable number of fishing smacks.

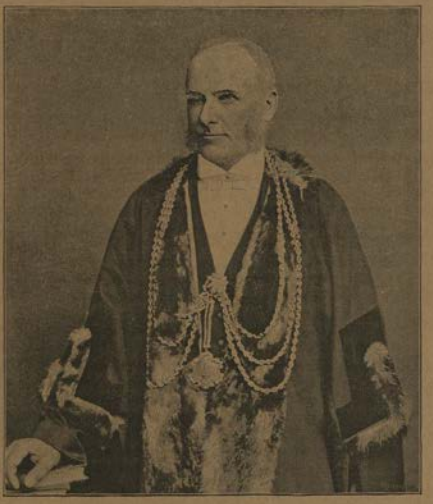
The business in question was founded in 1857 by Mr. H. Smethurst, at a time when this port was making its first efforts to attain to its present prominent position. He established himself in the double capacity of smackowner and fish merchant, and soon made arrangements to supply London as well as provincial towns with both fish and ice. From that time down to the present, Mr. Smethurst has kept well abreast with the growth of the industry, and has continued to hold the leading position. As bearing out this fact we may state that in 1858 about one-seventh of the tonnage of the sixteen Grimsby vessels engaged in the fishing trade belonged to him; and at the present time when nearly one thousand vessels of an aggregate tonnage of from 50,000 to 60,000 are thus engaged, the Firm of which he is the head still own and manage the same proportion, viz., one-seventh of the gross total; and they thus find employment for several hundred hands.

In 1872, Mr. Councillor H. Smethurst the son, and Mr. C. M. Mundahl, the son-in-law of Mr. Smethurst, were taken into partnership, since which time the business has been carried on under its present title as given at the head of this article.

The fishery by the Firm's vessels extends over a very wide area, including the length and breadth of the North Sea; round the Orkney and Shetland Isles; on the Rockall Banks in the Atlantic; at the Faroe Isles, and in Iceland. The fish caught annually by their own vessels represents an almost fabulous figure. In addition to this, however, they import large quantities of various kinds from Norway and other countries,

amounting during the respective seasons to about 20,000 barrels of herrings, 20,000 boxes of mackerel, 100,000 lobsters, and considerable numbers of salmon and trout. Part of the produce when landed at Grimsby is disposed of there, and the remainder is forwarded to inland markets extending all over England, Scotland, and Wales.

Mr. H. Smethurst, sen., has not confined his attention exclusively to the development of the large business with which his name is identified, but he has long taken an active part in promoting every movement that has tended to the prosperity of his native town. Some years ago he was elected an Alderman, and he brought his keen insight and marked business capacity with advantage to bear upon the duties which thus devolved upon him. Last year he was chosen to fill the important office of Mayor, and the highly



MR. H. SMETHURST, SEN., MAYOR OF GRIMSBY.

creditable manner in which he acquitted himself of the responsibilities of that post, prompted his townsmen to ask Mr. Smethurst to again fill that honourable position during the present Jubilee year. The portrait here given shows Mr. Smethurst in his robes of office.

Grimsby and its important Fishing Industry deservedly find a place in this ALBUM, since the prosperity of this port had its origin in the enterprise of such of her sons as the one whose business career we have here briefly traced; while, moreover, this enterprise has redounded to the advantage of the population at large by greatly increasing and cheapening an important branch of our food supply. That this latter statement is no mere figure of speech, but is founded on solid fact, may be inferred from this, that the value of the food derived from the Fishing Industry of Great Britain is computed at £12,000,000 sterling per annum.

Messrs. J. Harris & Sons, Derwent Mills, Cockermouth.

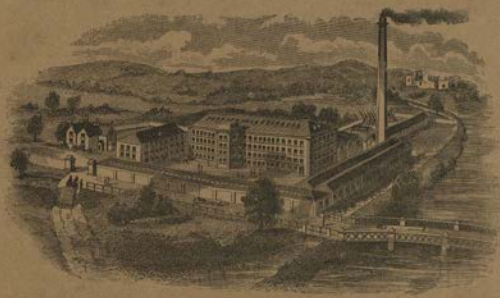
ON the right bank of the River Derwent in Cumberland, near its confluence with the River Cocker, from which the ancient borough of Cockermouth takes its name, and which has been remarkable in political history, as having been represented in Parliament by some of the foremost men of their day, and which will ever be memorable as being the birthplace of the poet Wordsworth; almost under the shadow of the ruins of the grand old Norman castle which overlooks the vale in which lies the little town; stand the Flax Mills of Messrs. Jonathan Harris & Sons; a great centre of industry in a scene of almost unrivalled rural beauty, which has often afforded opportunity for the exercise of the painter's art. From small beginnings these Works have grown into a large undertaking, capable of employing 1,000 operatives, many of them women and girls, and, as may be said to the credit of so many old-established Firms and their workpeople, the relations between employers and employed have, from the commencement, been of the most friendly character. This was early evidenced during the disturbed times of the Chartist riots, when a force of police was offered by the local authorities, for the protection of the Mills against possible violence, but was respectfully declined by the father of the present proprietor, with the remark, "I shall trust my workpeople to protect my property and their own source of livelihood"; and he was justified in his confidence in the good feeling and good sense of his operatives. No disturbance of amicable relationship, nor such misfortune as a "strike" has ever intervened, from the date of the establishment of the Firm in 1834 to the present day, to mar the harmony of co-operation for their mutual benefit between master and workpeople.

Some fifty years ago Messrs. Harris supplemented their original business of flax-yarn spinning and weaving by the manufacture of sewing-threads. Having followed up during its successive stages of development this particular line of the flax-spinning industry, and having kept themselves, by the application of the most approved methods and the most improved machinery, in the van of their competitors who have made excellence of quality their aim, they have obtained for their goods a reputation second to none in the markets of the world. In following up the idea that many qualities of excellence exist, but are so far but imperfectly developed, in many home-grown products, they have of late given their special attention to the capabilities of the fibre of flax, as a substitute for silk and other foreign fibres; and after having subjected it to processes which they have gradually, and at great cost, elaborated and perfected, the result is to show conclusively, that of all known fibres, vegetable or animal, flax, though most difficult to manipulate, is the one best capable of giving truly æsthetic effects.

Messrs. Harris & Sons have also found in the course of their experiments, that when treated by certain scientific processes, the fibre of flax is capable of receiving, and retaining permanently, almost all the various shades of art and brilliant colours which can be produced upon silk, wool, cotton, jute, or any other fibre,

and that with these colours can be obtained most exquisitely subdued brilliancy of lustre and mellowness of tone, both of which are essential in all high class embroideries, to whatever purpose they are applied.

Having thus proved the capability of flax as a colour-retaining medium, Messrs. Harris have devoted their attention to, and made a specialty of, the production of Pure Flax Embroidery Threads. These have now been some two years in their perfected state before the public, and have already procured a high reputation in the opinion of competent judges of such materials, they being applicable for all classes of embroidery, from the lightest etching and tracery on the finest fancy fabrics, to the solid and substantial work required in decorative upholstery; and are in constant use in the various schools of art needlework, ladies' guilds and work societies, and by producers of high-class embroideries both by hand and machine. Finished specimens of these can be seen at the offices and show-rooms of the Firm at 165, Queen Victoria Street



THE DERWENT MILLS.

London; in heraldry, ecclesiastical work, crests, monograms, household decorations and linen, ladies' fancy-work, &c.—the whole forming a very beautiful display of an absolutely new and unique description. This collection may aptly be called, the pioneer exhibition of what is destined to become a new industry, with a great future before it, and in which a home grown product will play a part which has hitherto been the exclusive prerogative of silk or other fibre of foreign origin.

Messrs. Harris & Sons have specially aimed at the production of an embroidery material combining the essential qualities of excellence and economy, and considering the effect produced, and the moderateness of price of their threads (it being about one-third that of good filoselle silk), it may certainly be said that they have succeeded in their object of encouraging the demand for a native fibre, for which the climate and soil of the three kingdoms are peculiarly well suited; and the development of a home industry of an elevating and remunerative character is in a fair way of being accomplished.

Mr. W. Gardner, Gloucester.

RAPID progress has been made in the last few years by the milling industry, especially in regard to the new, or gradual reduction process; and many flour-mills have now entirely discarded the time-honoured millstone, and use exclusively the modern roller-mills, purifiers, centrifugals, &c. Mr. William Gardner, who forms the subject of this article, has not been slow to see the advantage of the new systems and has laid himself out for the manufacture of the most modern and improved milling machinery. Having built new workshops for the purpose, he has had new plant set up also, specially suited for the manufacture of these modern machines, with which he has been highly successful. Several flour-mills are now working nothing but his machines, and with very satisfactory results. But, although such careful attention has been paid by him to the new system of milling, he still manufactures, for those who require them, millstones and other machines of the old type; indeed, every class of milling machinery is produced at his Works, whether for large mills or for small. As we have but a limited space at our disposal for a description of the same, we cannot do better than recommend those in want of such goods to apply direct to Mr. Gardner himself for any particulars they may require. But, as far as is possible, we will endeavour to describe some of the more important machines built at this establishment, which is one of the most complete of its kind in the United Kingdom.

The machine represented by Fig. 1 is a combined Separator, Smutter, and Brush Machine, and is intended for small millers who, for want of space or power, find it impossible to place a full line of grain cleaning machines. Although it embodies the principal features of the Separator, the Smutter, and the Brush Machine, however, we should mention at the same time that these machines are made separate also by Mr. Gardner.

Figs. 2 & 3. As can be seen from the illustrations on next page, these machines are driven by belt, and are quite noiseless. Fig. 2 is fitted with two pairs of rolls, and Fig. 3 with one pair, and when fitted with corrugated rolls are used for breaking wheat and cleaning bran. The corrugations vary according to the number of breaks they are used for, and when fitted with smooth rolls are used for reducing semolina and middlings.

Fig. 4. This 3-High-Roller Mill is designed for mills where space is limited, and is driven by one belt only, and is fitted with gear on the opposite side, which is covered with a cast-iron case, the bottom of which acts as a cup to hold oil for the gear wheels to work in, thereby considerably reducing wear, and causing the mill to run with little noise, and is fitted with corrugated rolls for breaking wheat and cleaning bran, and smooth rolls for reducing semolina.

Fig. 5 is a Centrifugal Flour Dressing Machine, which will be found to be simple in construction, well built, fitted with iron beaters, gun metal bearings, and of great capacity. The feed is conveyed into the machine by a worm on the main driving-shaft. A chamber is formed at the bottom of the inlet to the worm, into which any hard substance may pass, so as to prevent its getting into the worm and injuring same.

At the bottom of this chamber there is a door to enable it to be cleaned out. To prevent any lighter matter that may happen to pass this chamber and worm from getting into the silk or beaters, a wire cage is fixed inside, which also serves to break up and distribute the meal. They are made with two or more reels in one frame when required.

The improved Scalper is illustrated by Fig. 6, and is, like the centrifugals, fitted with gun-metal bearings, simple in construction, well built, and of large capacity. They are also made with one, two, or more reels in one frame to suit the requirements of the different mills.

Fig. 7. This combined machine is very simple and rigid in construction, and all parts are easy to get at, and it is specially designed to suit the convenience of small mills where space is limited and price an

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

FIG. 10.

FIG. 11.

FIG. 9.

object. As will be seen, only one main drive is required for the two machines, and as the roller mill is on the top, the rolled material goes direct into the dressing machine, and often saves the cost of a set of elevators, and the space required for the same. This machine can be used either as a first break to precede millstones, and so remove all dark dust from the crease of the wheat berry, which discolours the flour so much when ground up together; or for cleaning the bran after millstones, which will enable the stone miller to grind higher, and so make a more lively sack of flour, or a full line of them can be used for a complete roller plant; in that case the break rolls would be placed on the top of the scalpers (shown Fig. 6), and the smooth or middling rolls on the top of the centrifugals, and would form a very convenient and cheap roller plant, taking very little space or power, and when set in a line looks very nice and neat.

Fig. 8 is an illustration of a Corn-grinding Mill, on iron frames, with stones 36 in., 42 in., 48 in., or 54 in. diameter. The construction of these mills presents no special features, though the design is a careful adaptation of the means to the end desired. They pack for shipment in handy-sized cases, and are thus easy for transit on up-country roads. They are entirely self-contained, are easily fixed, and may be driven either by belt and pulley, as engraved, or by gearing if more convenient. All the bearings are of gun-metal, and the neck and toe bearings of the vertical spindle are adjustable. The bevel-wheels are geared wood and iron, and in every detail the mills are constructed in the best possible manner. Any number of them can be placed in a continuous line and driven by one lay shaft. They are fitted with French stones, or with a grey bedstone and French runner, or both grey stones, at the option of the purchasers. Buyers are requested to state their wishes in this respect when ordering. For general purposes French stones are to be preferred.

Fig. 9. The new Vertical Stone Grinding-Mill is suitable for grinding any kind of grain, dry colours, clay for fine earthenware, spices, &c. &c., and it is admirably adapted for shipment to any part of the world. As will be seen, it is mounted on a strong cast-iron frame, the stones running vertically; the grain, as it leaves the hopper, passes into a shaking shoe in which is a wire screen, which the corn has to pass through in order to keep back any nails or stones. This shoe carries the corn to the back of the fixed stone, and it is then fed into the mill by means of a worm working in the eye of the fixed stone. The stones are easily adjusted by means of a hand-wheel, and secured by a locking lever. By this means the stones can be set any distance apart, which does not vary whilst the mill is at work. They pack well for shipment, and are highly suitable for home and abroad. The stones will grind about 150 sacks without dressing. The mill is easily taken apart for dressing. This can be done with a little practice by the man or lad who looks after the mill. The stones being small there is little trouble in keeping them true. A pair of French burr-stones would last many years. They are made with stones varying from 12 in. to 30 in. in diameter.

Fig. 10. The special attention of those interested in the trade is invited to Mr. Gardner's large stock of French and other millstones of all sizes, for grinding all kinds of grain, cement, paint, drugs, coprolites, &c., as the principal quarries are frequently visited by him, and no trouble or expense is spared to purchase the very best qualities to suit their many requirements.

Fig. 11. The manufacture of belting for driving all classes of machinery is quite an important feature at these Works. Having suffered considerable inconvenience and loss through using inferior belting, and knowing the importance of having nothing but the best article to insure steady running, he decided some years since to manufacture it on his own premises, and now has none but the very best qualities.

In addition to the machines, &c., here described, Mr. Gardner manufactures gravity and sieve purifiers, bran dusters, and every other machine used in a flour-mill; also shafting, pulleys, carriages, hangers, &c. He is never without a full supply of mill furnishings of every description.

Messrs. W. A. & S. Smee, London.

FURNITURE was never cheaper than it is at present, but many of the showy articles which attract the attention of persons with limited means are not only cheap, but nasty. A little reflection on the part of buyers of furniture would save them much money and vexation. A good workman can always command a fair price for his labour, therefore it goes without saying that something must be wrong when goods are offered for sale at figures scarcely more than the value of the materials used in their construction. We have heard sad stories of the way in which furniture is "thrown" together by unprincipled dealers, and it behoves us to use a certain amount of discretion in selecting a house when the all-important question of furnishing has to be considered. In the pages of this work none but the Firms which bear the very highest reputations will be allowed to appear. Each great house must be a representative Firm, *sans reproche*.

The subject of this notice has long enjoyed the confidence of the public, and we have much pleasure in directing the attention of the readers of the ALBUM to the spacious show-rooms and works of Messrs. Smee, of Finsbury Pavement, manufacturers of house, hotel, and club furniture, where only the very best of workmanship is ever offered to the public. On the occasion of our visit to this old-established Firm we were shown into rooms fitted up in various styles where the purchaser can at once see the effect he might wish to produce in his own house. The drawing-room contained some beautiful specimens of artistic furniture, while the dining-room was a model of an apartment furnished in that substantial style so much admired by English gentlemen. Other rooms were fitted up to display to advantage the handsome suites of bedroom furniture. In this part of the building we noticed a great variety of handsome wardrobes, designed for utility as well as to produce artistic effect. The washstands, with their dark marble tops, tiled backs, and central mirrors, are veritable luxuries of the bedchamber. In another department we were shown a number of massive sideboards, all remarkable for excellence of workmanship and artistic design. One large show-room is devoted to over-mantels and cabinets. Some of the latter are beautiful specimens of ornamental furniture. In the bedding department, Messrs. Smee show a splendid assortment of brass and iron bedsteads. They are also noted for a special kind of spring mattress, which is a decided improvement upon the original French mattress.

A walk through the show-rooms of this Firm is sufficient to convince the visitor that the furniture exhibited is made to stand the test of age and climate. Messrs. Smee have undertaken some very large contracts in hotel furnishing. The Grand Hotel, Scarborough, was furnished entirely by them some years ago. The magnitude of this contract will be understood when we remind the reader that this hotel contains over 600 rooms. Bailey's Hotel and the South Kensington Hotel were both entirely furnished by Messrs. Smee. The rooms of Mr. Bailey's hotels are luxuriously fitted up. Costly cabinets and sideboards are to be found in ordinary sitting-rooms, giving these apartments more the appearance of rooms one is accustomed to find in

the mansions of the nobility than the suites of a public hotel. In addition to hotel furnishing, Messrs. Smee have fitted up a number of clubs.

They design all the furniture they manufacture, which is not usual in the trade. Their business transactions extend far beyond the United Kingdom. They ship furniture to various parts of the world, including the Australian colony, where they have a very large connexion.

The factory and timber yards are situated in King Henry Road, Ball's Pond Road, Dalston, where the woods are seasoned and carefully examined before they are handed over to the cabinet-makers. All kinds of decorations and interior fittings are most artistically carried out by Messrs. Smee, whose excellence of manufacture has earned them a number of prize medals, including the Gold Medal at the Sydney Exhibition and the Medal at the International Health Exhibition. The telegraphic address of this Firm is Smee, London, and the Telephone No. 178.

Mr. William Barker, Hebden Bridge, Yorkshire.

WEARING APPAREL made of Fustian has been in use in this country for many centuries, and we have an authenticated record of the year 1114, in the form of an edict by St. Stephen Harding, a Cistercian monk, forbidding the chasubles in his church to be made of anything but fustian. The material would appear to have subsequently become quite a fashionable fabric, for Chaucer makes mention of a knight who was clothed in fustian; and there is evidence that about the same period it was worn by the nobility; and Fuller, the Church historian, records that in earlier times, to use his own quaint language, fustian was "creditable wearing in England for persons of the primest quality." Certain descriptions were, indeed, considered so valuable that in the time of Edward IV. a sumptuary law was enacted against the wearing of Italian fustians, except by the wealthier classes. Moreover, the present writer only lately came across a reference showing that the fabric must have been held in equal estimation in France, for an entry in the Privy Purse expenses of Louis XI. shows, under the year 1461, that two shillings were spent "for fustian to new-sleeve His Majesty's doublet."

This particular industry, it will be seen, boasts thus an exceptional antiquity, and if no longer worn by crowned heads or the nobility, fustian forms, nevertheless, an indispensable material for clothing; and it is probable that the quality of that worn by our present-day mechanics is far superior to that formerly employed in the garments of the French King or the English aristocracy. The great perfection to which the manufacture of fustian has been brought in recent years is strikingly demonstrated in the extensive factories and warehouses of Mr. William Barker, at Hebden Bridge, which we intend to describe in the present article. The business was established, fifty-two years ago, by Mr. William Barker, who, after a career of exceptional activity, hard work, and plodding perseverance, has lived to see his business develop to its present exceptional proportions, comprising now, as it does, four extensive and distinct mills, viz., the Wood Top, the May Royd, the Hudson, and the Land Mills, the first three of which are illustrated on subsequent pages. We also give herewith a portrait of Mr. Barker, who during the years of his life has witnessed the introduction and growth of the Factory system in this country, and the revolution in all branches of productive industry which it was the means of initiating. He himself may proudly claim to have been largely instrumental in fostering the fustian manufacture, and to have introduced important improvements which have contributed to its expansion and growth.

After a lengthy and prosperous career extending over more than half a century, Mr. Barker some time ago withdrew from the business, and is spending his declining years in well-deserved retirement. The concern, however, still remains in the family, being now owned by his son-in-law, Mr. John King, and the two sons of the latter, Mr. Harry Whiteley King and Mr. Herbert King. Having regard to the energy, administrative capacity, and high principle which they have brought to bear upon their duties, no wonder

that, under their guidance, the concern has continued on its onward progress, and ranks to-day as the first of its class in Hebden Bridge, and as one of the largest in the United Kingdom.

Established originally on a comparatively small scale, the business has grown by degrees, until it now embodies every branch of the fustian trade; and at one or other of the Firm's mills are carried on all the various processes connected with bleaching, dyeing, finishing, and the manufacture of ready-made clothing from the above material; and for its comprehensive character the establishment of Mr. Barker stands to-day unrivalled, while at the same time it is the oldest wholesale clothing manufactory in Hebden Bridge.

Under the courteous guidance of one of the partners we had an opportunity of visiting the Hudson Mill, which is illustrated on the next page. It is situate high up among the hills in a part of the West Riding of Yorkshire renowned for charming scenery. This mill is set apart for the weaving of fustians, and here we found at work winding machines, warping mills, doubling frames, and a large number of power-looms. Every department was in full swing, and the yardage produced in this one mill during a twelvemonth

MR. WILLIAM BARKER.

must be something enormous. There is, however, be it remembered, a second mill, where similar operations are carried on, on a correspondingly large scale, and the annual output must thus represent a total which is not easily realisable. At these mills, besides various other operations, the warps are made and woven into fustians, twills, &c., and the double agency of water-power and steam-power is called into requisition for imparting motion to the large number of elaborate machines here at work. The other factory, the Land Mill, devoted to manufacturing processes of a like nature, is also situated in rural seclusion, at some distance from the present one.

All the "pieces"—to use the technical phraseology—made at the other mills find their way ultimately to the Wood Top Mill, an illustration of which appears on a subsequent page. Like those already mentioned, this factory, too, presents a very busy appearance, and gives remunerative employment to a large number of persons. The operations here carried on are so many in number that we cannot refer to them in detail. The "pieces" are first dried by being passed over steam-heated cylinders. Among the subsequent processes are carding, viz., raising the back with cards; the cutting of the pile by hand, which produces the ribbed surface;

the "ending and mending," to ensure uniform good quality; and the scouring and raising of the pile. After this the material is drained, and then hung up to dry on staves or racks in the stove, at a temperature of about 150 degrees. By the aid of dressing machines the pile is next raised, different machines being employed according to whether the fabric is to be plain or silk finished. Uniformity of surface is ensured by firing or "gasing." After this follow the dyeing processes, which are of a complicated character, and into which the science of chemistry largely enters. From the dye-house the cloth is again returned to the drying stoves. According to the finish required, it is then passed through the stiffening machine; while such fabrics as twills, sateens, &c., are operated upon by the calendering machine. The other machinery at work includes finishing machines, by which a glossy surface is produced; plaiting machines, for making up "pieces"; shearing machines, for moleskins; and moteing machines, for cleaning the face of twills, sateens, &c. The name of the last-mentioned apparatus is evidently derived from "mote," a word which means, *inter alia*, "a small knot on cloth," for the machine in question removes even the slightest speck which may adhere to the surface of the material. In every department where it is possible to do so with advantage, labour-saving appliances of the latest and most improved type are brought into requisition; and both a steam-engine and a turbine are employed for the purpose of imparting motion to the same.

Independently of carrying on the whole of the manufacturing and dyeing processes in connexion with their own productions, the Firm also undertake the dyeing and finishing for other manufacturers and merchants who have not the same facilities; and this branch of the business has also been developed to a very considerable extent.

MANUFACTURING DEPARTMENTS, HUDSON MILL.

We pass on now to another department—the May Royd Works—which almost adjoin the Railway Station. These Works, as will be seen from the accompanying illustration, form a large block of buildings, comprising a basement and four storeys above. They are fitted up in a superior style, and are specially adapted for the business carried on. A lift communicates from the basement to the different floors; while speaking tubes and electric bells facilitate intercommunication between the counting-house and the several departments. The energy and enterprise of the proprietors are here illustrated incidentally by the fact that the electric light is fitted up throughout—a convenience of the utmost value where the handling and matching of textile fabrics is concerned.

The basement is set apart for the storage of grey goods as they come from the loom, and the stock of these on the occasion of our visit was a large one. On the first floor are the offices, and a spacious stockroom (measuring some 120 ft. by 50 ft.) where some thousand "pieces" are stored. These include cords, moleskins, twills, and sateens. Familiar as are most people with such goods, probably but few are aware of the many superior fabrics that are made in these classes. The variety of patterns is quite bewildering, and many of them are far superior to what one generally associates with children's suits or workmen's garments. Not a few of these fabrics resemble in texture, appearance, and quality some of the best velveteens; and they might with advantage be utilised for different purposes. In the matter of colour, too, there is an almost endless diversity, and some of the shades represented are extremely soft and delicate, while all are highly effective. In many of the lighter colours the purity and uniformity of tint are admirable, and reflect the greatest credit upon the resources of the Firm's dye-house. The fittings, shelving, &c., in this room are most conveniently arranged, and excellent daylight facilitates the examination of the goods by wholesale buyers.

The second floor forms a stockroom for made-up clothing, and probably from 70,000 to 100,000 knicker suits, boys', youths', and men's suits, and single garments, pass annually through this department. On the third floor one room is set apart for receiving all piece goods sent up for cutting and making up; while in the adjoining and far larger apartment the garments are cut out both by machinery and hand. Long rows of sewing machines are at work near by, engaged in making up the various articles of clothing. All these, as well as the cutting machinery, are set in motion by the aid of water-power, by which latter the dynamo machine for the electric light is also driven. The girls and women attending to the sewing machines are thus saved all hard labour. The fourth floor is occupied by women engaged in finishing by hand. In addition to the large staff here employed, a considerable quantity of work is given out to be finished at the homes of workers.

CUTTING, DYEING, AND FINISHING DEPARTMENTS, WOOD TOP WORKS.

CLOTHING, &c., DEPARTMENTS, MAY ROYD WORKS.

Thus, then, we have briefly glanced at a business which in its various ramifications has contributed materially to the prosperity and growth of Hebden Bridge, while at the same time benefiting the many thousands of artisans and others whose hands the garments here made ultimately reach. We say advisedly benefited, for the quality of the goods produced is unsurpassed—a fact fully realised and acknowledged by tailors and clothiers, who know how to value the standard excellence of all clothing bearing the accompanying trade-mark of William Barker; while colonial buyers and shippers are equally alive to the import of the above initials, and the voucher which they afford of good value for the money paid. It is, indeed, mainly due to the attention paid to the quality of the productions that the Firm has attained its present celebrity.

Each of the mills, as well as the "Making-up Department," is presided over by a competent foreman. On going through the Works, we were much gratified to find that every provision has been made for the comfort and convenience of the employés, and cleanliness, light, and airiness are characteristic of all departments. The writer himself has carried away with him a very pleasing recollection of the uniform kindness and courtesy shown by Mr. King, senior, and by his two most genial and obliging sons.

Sufficient has been said above to show that among the bead-roll of English worthies connected with industry a place is due to Mr. William Barker, whose business career has been distinguished by uprightness, integrity, and all the other virtues which have ever characterised our great leaders of commerce. His mantle has evidently fallen upon worthy successors, and the present proprietors—the three Messrs. King—actuated as they are by singleness of heart, by a scrupulous regard for the interests of their customers, and by the strictest honour—will not fail to hand down to future generations the high traditions and moral principles which guided the founder of this flourishing business.

Not only was Mr. Barker the founder of this Firm, but he was the Pioneer of the Clothing Trade in Hebden Bridge, and the present marvellous development to which this branch of industry has attained locally, is a lasting monument to his keen insight and devoted energy. His name is thus one that deserves to be held in honour not only in his native place, but also in the annals of Commercial England.

Messrs. Isaac Dixon & Company. Windsor Iron Works, Liverpool.

THE discovery by Galvani, of Bologna, of a species of electricity, usually developed by the mutual action of various metals and chemical agents upon each other, was not destined to remain an incident of importance in the sphere of science alone. It has proved of great practical value to the manufacturing world, and with the results of the process named after the Italian, as applied to articles of commerce, we are familiarised by many objects around us. The corrugation of iron is accomplished by means altogether mechanical.

Since Her Majesty's accession, an important branch of English industry has arisen in the manufacture of Galvanised and Corrugated Iron, with which innumerable buildings are now framed and covered. A natural corollary to the construction of ships of iron and steel has been the erection of public and private buildings in the same materials; but, notwithstanding the progress which has been made in this last department, it may be said to be yet in its infancy. Where stone, brick, or wood are unobtainable, or are undesirable on the score of expense, iron may be used for building purposes with manifest advantages, and with a comparatively small outlay of capital. From the points of view of sanitation and ventilation, it has merits entirely its own, and not only is it adapted to the requirements of tropical countries, but in cold climates also it may be used for the provision of warm and substantial buildings necessary to the comfort and convenience of civilised or semi-civilised communities.

The galvanising process is simple yet interesting. The black iron, as rolled, is first placed, for a short period, in a tank filled with muriatic acid—this operation being technically known as "pickling." The metal is then taken out, scraped and cleaned in water, and passed through a bath of molten spelter, or zinc, which impregnates the iron, and renders it impervious to rust. The spangled appearance of a galvanised sheet immediately after the bath is exceedingly brilliant and silver-like. To give the needful rigidity to the plates or sheets, for roofing and similar purposes, they are submitted to a stamping machine, which corrugates, or flutes, the iron, thus ~~~~, and greatly increases its strength. The value of corrugating may be readily understood when it is mentioned that iron plates treated in this way to acquire more strength are now made into flues and largely adopted on Her Majesty's iron-clads as well as on ocean-going steamships.

In roofing and general building, the chief features in favour of corrugated iron are lightness and durability, allowing of its application in sheets of large size to roofs of considerable span and almost without frame-work. It has come to be considered a most efficient and economical material for nearly all varieties of roofing. The buildings in many towns of the colonies are constructed mainly of galvanised and corrugated iron, with iron or wood frames; and visitors to the late Indian and Colonial Exhibition could not fail to be impressed with the fact, as illustrated by the numerous photographs displayed.

Among the Firms who have taken the lead in the introduction of iron for work of this kind, Messrs Isaac Dixon & Co. occupy a foremost place, by reason of the energy with which they have pursued their

operations, and given to them a universal character. During a lengthened period they have devoted themselves to the development of this branch of industry, and their constructional enterprise has ranged from the plainest to the most ornate building. They have erected thousands of roofs and premises for agricultural, colliery, mining, engineering, and railway uses; also for dock-sheds, warehouses, drill-halls, hospitals, pavilions, dwelling-houses,

CHURCH, LIVERPOOL INTERNATIONAL EXHIBITION, 1886.

CHURCH ERECTED AT TU-WON, BRASS RIVER, WEST COAST OF AFRICA.

SPORTING LODGE, MANCHESTER JUBILEE EXHIBITION, 1887.

IRON HOUSE ERECTED AT LAGOS, WEST COAST OF AFRICA.

churches, exhibition buildings, both at home and abroad—in a word, the important contracts fulfilled by them pertain to all quarters of the globe. For a number of years special governmental contracts for all galvanised and corrugated iron required for home and foreign stations have passed through their hands. The following is a brief

INTERIOR VIEW OF CARNARVON PAVILION.

HOUSE ERECTED AT PERIM.

INTERIOR VIEW OF CHURCH ERECTED AT TU-WON, BRASS RIVER, WEST OF AFRICA.

INTERIOR VIEW OF ROOF ERECTED FOR THE BRYMBO STEEL AND IRON CO., BRYMBO.

EXHIBITORS' CLUB, MANCHESTER JUBILEE EXHIBITION, 1887.

INTERIOR VIEW OF NEWCASTLE DRILL HALL.

summary, with illustrations, of a few of the principal roofs and buildings designed and carried out by them:—

Carnarvon Pavilion and Concert Hall, accommodating about 10,000 people, and pronounced to be one of the largest and finest iron buildings ever erected. Bazaar and Market at Rangoon. This extensive and substantial structure is composed entirely of iron, and was erected by natives from plans supplied by the Firm. St. George's Hall, Newcastle-on-Tyne, with a roof of ninety feet span. Iron roofs of seventy to ninety feet spans, with

suitable girders and columns, erected at Brymbo Steel Works, near Wrexham. The stability of this work was put to a severe and unusual test by an accident which recently occurred. A huge fly-wheel, of enormous weight, burst, and the fragments were hurled through the roofing, tearing away girders and supports. Notwithstanding this damage, the roof did not collapse, and was repaired without being taken asunder. Large series of iron roofs, with girders and columns, for machinery-sheds, in ship-building yards at Port Glasgow, Stockton, and other ports, are also erections of Messrs. Dixon.

In connexion with the Niger Mission of the Church Missionary Society, three large iron churches were built by the Firm and shipped to West Africa. These churches were erected also by natives with the aid of Messrs. Dixon's plain directions and detailed plans, which they always supply in such cases. Every building intended for export is temporarily erected at the Works, and the various parts and sections are carefully marked,

BAZAAR, RANGOON.

REID'S ROOFS, ERECTED AT PORT GLASGOW.

for guidance in re-erection. The iron church at Ambleside, Windermere, as illustrated, was exhibited by Messrs. Dixon at the Liverpool International Exhibition in 1886. A tropical residence,—erected at Lagos for a telegraph station by the Firm's own workmen, who were specially sent out,—has a frame entirely of iron, and was designed with a view to ensure efficient ventilation in this hot climate. It was exhibited at the same Exhibition, together with the club-house, as shown.

An illustration of one of several houses and buildings erected by Messrs. Dixon's own men at Coaling Station, Perim Island, for staff and other purposes, is likewise given; also a view of a neat and attractive residence which now stands in the Royal Jubilee Exhibition, Manchester. An important and novel application

WINDSOR IRON WORKS, LIVERPOOL.

of galvanised iron is Dixon's patent safety edge self-fixing fencing standard, which is made in one piece for wire fencing. For this they obtained the Gold Medal (highest and only award) at the Liverpool Exhibition. The rapidity with which Messrs. Isaac Dixon & Co. complete the most elaborate structures committed to their care is a noteworthy feature of their business, the extent of which is demonstrated by an inspection of their premises, where a large staff of skilled workmen is permanently employed. The Firm have constantly on hand contracts, of which one of the chief conditions is immediate execution within short periods. The highest award was bestowed for their buildings at the Liverpool International Exhibition of 1886, and Messrs. Dixon have been the recipients of numerous other honours for excellence of construction and artistic merit.

Messrs. Ashmore, Benson, Pease, & Co., Limited, Stockton-on-Tees.

REASONING against a prejudice is like fighting against a shadow. This was the experience of Murdock and the other pioneers of gas-lighting. Their proposals for using gas as an illuminating agent were ridiculed even by men of science, and Sir Humphrey Davy thought lighting a town by gas so visionary a scheme that he asked Clegg—one of Murdock's disciples—whether it was intended to take the dome of St. Paul's Cathedral for a gasholder. Clegg replied that he hoped to see the day when gasholders would not be much smaller. This prediction has been more than realised in recent times, as we shall have occasion to show in the course of the present article.

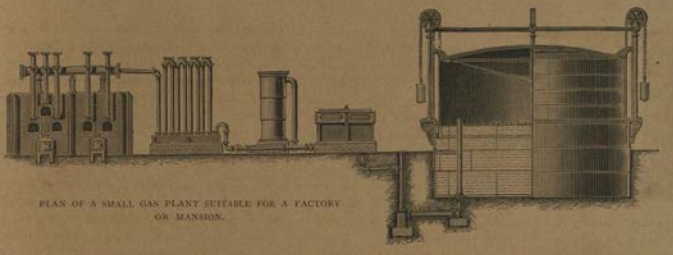
In our own day the consumption of gas has assumed proportions that even the most sanguine of promoters could not have dreamt of fifty years ago; the quantity annually used in this country being now probably about 80,000,000,000 cubic feet, a figure which it is impossible for the mind to grasp. As a matter of course, this greatly-increased consumption has necessitated the supply of larger and more productive gas plant than was formerly employed. This has in turn led to the establishment of huge concerns which make the supply of gas apparatus their specialty. Messrs. Ashmore, Benson, Pease, & Co., Limited, of the Gasholder Works, Stockton-on-Tees, may be taken as a Firm typical of this particular industry, for the manufacture of gas apparatus is carried on by them on scientific principles, and the scale on which the business is conducted places them far and away ahead of all their competitors.

Their Works, which cover about ten acres of ground, are situated in the centre of the northern iron district. They adjoin the railway, and a private siding connects their premises with the main line; in addition to which they have special facilities for shipping from the port of the Tees. The whole of the buildings, yards, &c., are planned on a large and comprehensive scale, so as to be adapted to the production of every variety of gas plant. The Works comprise a commodious drawing-office, in which we noticed a number of clever draughtsmen busily engaged in working out designs. We next passed through a long range of extensive boiler, smith's, fitting, and pattern shops, a large foundry, and capacious sheds for punching, riveting, and setting out work. Everywhere we observed the most improved and perfect types of labour-saving machinery and steam tools, many of them being the Firm's own patented inventions, and the precision with which they work fills the beholder with admiration.

Rather than following the manufacturing processes we will turn our attention to the productions in connexion with which the Firm's name is known in every part of the world, where the civilising agency of gas has been brought into requisition. Gasholders are the leading specialty, and most of the largest gas works, public and private, have been fitted up by Messrs. Ashmore, Benson, Pease, & Co. The number of the more important contracts executed by them exceeds 200, and it may be mentioned incidentally that many

of the largest manufacturing establishments described in this ROYAL ALBUM have had their gas plant fitted up or rearranged by the Firm under notice. There are, indeed, comparatively few great towns throughout the Kingdom where one or more of their gasholders may not be found, as the following list will show:—Ashton-under-Lyne, Berwick, Birkenhead, Birmingham, Barrow-in-Furness, Bolton, Carlisle, Doncaster, Darlington, Eastbourne, Edinburgh, Falmouth, Hartlepool, Manchester, Middlesbrough, Newcastle, Sunderland, Scarborough, Stockton, Southampton, Stockport, Tynemouth, and West Hartlepool. We must stop here, for the enumeration of all the other places would occupy as much space as we can devote to this whole notice.

No mention has thus far been made of London, where after all some of their most important works are to be seen, notably the immense structure erected in 1882 in the Old Kent Road for the South Metropolitan Gas Company. This is a three-lift gasholder of 214 ft. diameter and 53 ft. deep, having the enormous capacity of 5,665,137 cubic feet of gas! Until recently this has been the largest gasholder ever made; but even its size is greatly exceeded by the truly Brobdingnagian proportions of the four-lift gasholder which is now being erected by the Firm for the same Company at East Greenwich. This is 250 ft. in diameter, and 45 ft. deep, and when inflated, the four lifts will rise to the enormous height of 174 ft.! By the side of this, the proportions of the dome of St. Paul's (the interior of which is only 108 ft. in diameter) dwindle into insignificance, and yet, as before mentioned, in the early part of the century Sir Humphrey Davy thought it the wildest chimera to conceive of a gasholder being built as large as that dome. Still more astonishing



PLAN OF A SMALL GAS PLANT SUITABLE FOR A FACTORY OR MANSION.

is the holding capacity of this new mammoth gasholder; for in it can be stored 8,250,000 cubit feet of gas, being, roughly speaking, 50 per cent. more than in the one already alluded to as having been hitherto the largest in the world. One wonders what Sir Joseph Banks and the other wiseacres of the Royal Society—who urged Government to insist that no gasholder should be erected to contain more than 6,000 cubic feet—would have said to this latest marvel of engineering skill. This king of gasholders will doubtless hold undisputed sway for many a year, and when (if ever) it should be superseded by a larger one, past experience justifies the belief that only Messrs. Ashmore, Benson, Pease, & Co. will be equal to producing anything of a more Cyclopean character.

Several of the other London Companies, including the Surrey Consumers', the Crystal Palace, and the London Consumers' Companies, have been also supplied with gasholders by this Firm. They, moreover, manufacture every description of condensers, scrubbers, washers, retort fittings, hydraulic, foul, gas, and water mains, wood grids, and all kinds of other gas apparatus. In addition to this at their Works are produced tanks, roofs, bridges, girders, boilers, lamp columns, valves, and other cast-iron work of great variety. A considerable amount of work in the form of gasholders, bridges, &c., is done for export, and several such articles for Colonial markets were in course of construction on the occasion of our visit.

The managing directors are Mr. W. Ashmore, Mr. R. Seymour Benson, and Mr. E. Lloyd Pease—three gentlemen whose exceptional qualifications for presiding over such a concern are best attested by the great extension which the business has undergone during the last few years. It is worth adding that Mr. E. L. Pease, before mentioned as a partner, is a member of the famous Pease family who have proved such great industrial benefactors to the North of England.

Mr. John Walsh Walsh, Birmingham.

TRACING back its origin into the dim past, the art of glass-making has undoubtedly contributed more to the comforts and conveniences of life than any other single industry. Glass, in the characteristic language of Dr. Johnson, is a body at once in a high degree solid and transparent, and admitting the light of the sun, while excluding the violence of the wind. The toy of childhood, the mirror of beauty, and the ornament of luxury, glass may claim to be one of the most useful appliances of ordinary life. Turning aside, however, from the general aspect of the subject, our immediate concern will be with that branch which relates to the working of flint glass—a branch which contributes most to the adornment of our homes. In Birmingham, the manufacture of flint glass first took root about a century ago.

Among the earliest factories established were the Vesta Works, built by Mr. Shakespeare, and afterwards carried on by Mr. Walsh Walsh. These Works are one of the few which have survived to the present day, and, what is more, they are now in a more flourishing state than they have ever been before. By reason of the artistic element which has been specially fostered here during the last few years, as well as by reason of the improvements in other directions which have been introduced, we have selected the business carried on under the title of John Walsh Walsh as typical of this industry. Shortly after the death of Mr. Walsh, in 1864, his son-in-law, Mr. T. F. Walker, took over the business. This gentleman is also an extensive manufacturer of nautical instruments, and has created a world-wide fame for himself in connexion with his clever invention of new patent "Ship-logs," which will be found fully described and illustrated under that heading in this ALBUM.

His other business, already referred to, making increased demands upon his time, Mr. Walker some five years ago took into partnership Mr. L. J. Murray, a gentleman of considerable experience in this branch, and a thorough enthusiast in all that concerns the artistic development of flint-glass making. From that time the business has taken a new departure; the scope of its operations has been considerably enlarged, and the variety of its productions greatly added to, so that the Soho and Vesta Glass Works, Birmingham, in which the manufacture is carried on, promise to become one of the most important factors in the artistic development of this department of the glass trade. The Works adjoin the canal, so that the coal required can be brought in the Firm's own boats to their private wharf. As the quality of the coal is of the utmost importance in firing glass, men are specially sent to the collieries to select the right description. A large new glass-house and furnace had been just completed at the time of our visit; these will enable the output to be doubled. The furnaces are arranged upon an improved system, by which the fuel is fed in from below instead of being thrown on the top of the fire. Besides insuring complete combustion, this plan has other advantages relating to the quality of the articles produced. The comfort of the employés has also been studied in the construction of this new glass-house, ample provision having been made for fresh air and good ventilation.

The initial stages of the manufacturing processes are few. After the various ingredients of which glass is composed have been mixed, they are melted in crucibles at a high temperature until the mass is rendered quite liquid. The principal points to be attended to in preparing the "metal,"—as the fused glass is called,—are purity of colour, brilliancy, and freedom from striæ, in all which respects the productions of these Works stand probably unsurpassed. While still in a plastic state, the glass is fashioned into the various articles of ornamental, decorative, and table ware which form the specialty of the Firm. The numberless varieties of shape render it impossible to give a description of the processes adopted. We must content ourselves by saying that there is no branch of human industry which it is more interesting to watch than that of manipulating glass as here carried on. To see a substance, proverbially brittle, blown by the human breath, pulled, twisted, cut, and then joined again with the greatest facility, elicits the beholder's surprise and admiration. All this is effected with the simplest of tools; and it is here that the highest skilled labour is brought into requisition; for machinery and contrivance are out of the question, and everything depends upon the trained eye, the dextrous hand, the cultured taste, and the individual aptitude.

Next in order follows the annealing—a slow and important process. This is carried on in lears, in which the glass is gradually passed from an atmosphere of intense heat to one of comparative coolness. At the Soho and Vesta Glass Works a new lear has been just constructed alongside of the old one. It is built on an improved principle, has double sides, and the charging and emptying are greatly facilitated by the aid of a continuous chain. The winding apparatus can be readily thrown in and out of gear, and one wheel is made to serve for winding both sides. This lear is 30 feet long; and for heavier work special annealing kilns are available. Other necessary plant and machinery are also provided, as well as cutting, engraving, sorting, and store-rooms, &c.

In the show-rooms attached to the Works may be seen representative samples of the Firm's productions. Ample evidence is afforded by the magnificent goods shown of the signal progress that has been made in the art. Here we see forms of lovelipess and beauty, in every degree of transparency and in every shade of colour. In whatever direction we turn we are met by works which emulate in richness and brilliancy the topaz and ruby, the emerald and amethyst. In some the effect is heightened by the cutter's stone, in others by the engraver's wheel. All alike are characterised by gracefulness and symmetry of shape, suitability of ornamentation, and harmony of colouring. The display includes ornamental glass in the highest style of art, table and cabinet ornaments, glass of every description for silversmiths, electro-platers, and metal-workers. Having inquired the prices of some of the choicest articles on view, we can aver that these are such as cannot fail to insure a large demand and adapt them to every market. Moreover, instead of decorative glass having to be largely obtained from foreign makers, as was the case formerly, the Firm under notice are able to supply English dealers with more artistic and better finished goods, and at a lower price, than those that come from abroad.

Experiments are being constantly made in order to produce new and striking effects, and how very successful many of these have proved is shown by the charming examples before us. The effects obtained in cameo-cutting are exquisite. In some cases as many as seven different layers of glass are placed one over the other; some of the layers are then partially removed, and the designs worked out by the artist and the engraver. The result is truly superb. Various other modifications of decorative processes are also adopted, some of them being the Firm's own patented inventions.

One other point which strikes the observer in going through the Works is the harmony prevailing both between employer and employed and between all members of the staff, from the highest to the lowest. The two partners, Mr. Walker and Mr. Murray, are among the most courteous and genial of gentlemen, enthusiastic in the pursuit of their vocation, in which monetary considerations are never allowed by them to stand in the way of perfection of result. Their example has influenced those around them, and, by fostering the cordial co-operation of the heads of departments and by insuring the assistance and good feeling of the operatives, it has contributed materially to the exceptional success which has attended the business. It only remains to add, that at the recent Liverpool Exhibition a Gold Medal was awarded to the Firm "for Cut Glass and for improvements in Decoration of Ornamental Glass," while a Bronze Medal (the highest award in the section) was allotted for "Glass for Ships' Lanterns," to which latter branch of manufacture, although brought to great perfection here, we cannot, for want of space, refer in detail. An inspection of the London Show-rooms, at 4, Holborn Circus, will convince any one that the sentiments expressed in the course of this article are in no sense exaggerated.

Messrs. Wright & Bull, Birmingham.

ONE hardly realises, until one begins to think, how largely gold leaf enters into the manufacture of useful and ornamental objects; and yet, whether in the street or at home, in church or at the theatre, in the rich man's hall or in the poor man's parlour, the eye seldom ceases for very long to rest upon objects which gold leaf has not in some way or other helped to decorate. But there is no necessity, nor would it be possible in this article, to describe the many and various purposes to which the product of the gold-beater's hammer and anvil are applied.

Gold leaf is one of the thinnest commodities, if not the thinnest, which the skill of man can produce. It is estimated that, to form a pile an inch in thickness, from 200,000 to a quarter of a million leaves would be required; and many interesting calculations have been made, forcibly illustrating the extraordinary malleability of gold and the marvellous degree of thinness to which the leaf may be beaten. For example, a single ounce of the precious metal when converted into leaf would cover a surface of 100 or more square feet. Although the manufacture of gold leaf can never become an industry of colossal magnitude, it is an extremely ancient art; indeed, gold-beating is one of the oldest arts that are mentioned in Classical and Biblical history. Strange to say, however, but little has been done in the way of adapting modern inventions to its development, and all the work, with the exception of the mill-rolling, is still done by hand. The wages of the gold-beater, although he is constantly working with so valuable a metal, are scarcely better at the present time than those of a bricklayer's labourer.

The process of manufacturing gold leaf, which is very simple, may be briefly described as follows:—First of all, pure gold is obtained from the refiner, and alloyed with a very small proportion of silver and copper, which give the various shades required. The best quality of leaf is made with 23-carat gold, that is, with an alloy of which $\frac{23}{24}$ are gold and $\frac{1}{24}$ is not gold. The mixture, having been prepared, is melted in a crucible and poured into an ingot mould, and is thus formed into a bar about 1 in. in thickness and from 8 to 10 in. in length. When this bar has been rolled by a mill into a ribbon about $1\frac{1}{4}$ in. wide and $\frac{1}{1000}$ of an inch thick, the work of the actual gold-beater begins. The ribbon is dealt out to him by weight, and he cuts it into pieces about $1\frac{1}{4}$ in. square, and builds up what is technically called a "cutch." This consists of something like 180 sheets of tough oiled paper $3\frac{1}{4}$ in. square and an equal number of the pieces of gold ribbon, piled alternately one on another,—first, a sheet of paper, then one of gold, then another of paper and another of gold, and so on. Two parchment bands are fastened round the cutch at right angles to each other, and the whole bundle is then placed on an anvil and beaten with heavy hand-hammers, until the small sheets of gold expand to nearly the size of the sheets of paper. The beating is done with 16-pound to 10-pound hammers on a cubic iron anvil, placed on a wooden block. Each piece of gold is now taken out of the cutch and cut into four pieces, and what is termed a "shoder" is constructed; that is to say, some 700 of

these small pieces of gold and an equal number of sheets of gold-beater's skin 4¼ in. square, are piled one on another, and the whole packet, as in the case of the cutch, is fastened with bands of parchment. Gold-beater's skin is a membrane obtained from the internal parts of the ox, and is used for this purpose on account of its toughness and thinness. The shoder is beaten in the same way as the cutch, until the small sheets of gold spread out to nearly the size of the sheets of skin; then they are again taken out and quartered, and the quarters, having been placed between other sheets of skin slightly larger than those used before, are beaten out to their final dimensions. A pair of box-wood tongs or pincers is used to remove the delicate leaves from the "mould," as this last pile of 900 skins and gold is called. Each leaf is placed on a leather pad, and its edges are trimmed off with an instrument known as a "wagon." This apparatus consists merely of two knife-shaped strips of Malacca cane, fixed in a frame, 3¾ in. apart, and parallel to each other. By taking off two opposite edges at a time with this double knife, and by being careful when taking off the second pair of edges to place the instrument exactly at right angles to the direction in which it was placed

MR. SAMUEL WRIGHT.

for the first pair, the gold-beater obtains a perfectly square leaf, with sides 3¾ in. in length; and the product of his labour is now ready to be placed in the market. For convenience in handling and in transit, the squares of gold leaf are placed between the leaves of a paper book; and, packed in this way, they are despatched to their various destinations. The trimmings which were taken off the edges are collected and melted down again.

Among the oldest and most important Firms of gold and silver leaf manufacturers in this country,—if, indeed, it is not positively the oldest and most important,—is the Firm of Messrs. Wright & Bull (successors to Messrs. Joseph Lane & Son), the progress and development of whose business may almost be identified with the progress and development of this branch of manufacture during the present reign. It was about sixty years ago that Mr. Joseph Lane commenced business in Caroline Street, but soon removed to No. 3, Great Charles Street, Birmingham; and so successful did the Firm become that at one time it almost held a monopoly of the gold and silver leaf trade. When his only son, Mr. Thomas Lane, was taken into partnership, considerable additions were made to the business by combining with it the

manufacture of bronze powders and metal leaf. The manufacture of varnishes, also, was begun at other works in Alcester Street; and, in order to secure purity and good quality in the metals used in the manufacture of their leaf, the business of bullion dealers and refiners as well was taken up by this enterprising Firm. It will thus be easily understood, from the facilities they possessed for producing the very best quality of leaf, that Messrs. Lane & Son held a position quite at the top of the tree in their particular line. But, owing to the severe competition both from home manufacturers and from foreigners which has of late sprung up, the demand is not such as to call for so large an output from these Works now as formerly. The foreign leaf which is imported is, no doubt, cheap, but it has not the same durability as the English article. The trade of the English gold-beater has been almost entirely destroyed by foreign competition; during the ten years, 1875 to 1884, the gold leaf imported from abroad amounted to £1,223,418; this quantity, taken from the comparatively few people engaged in the trade, represents a very heavy loss of employment. About thirty-five years ago there were some 2,000 working gold-beaters, now there only remain about 1,000, and not more than 400 of these were at work last September. At the present time it is estimated that barely 200 men are working at the trade, though a generation ago ten times that number were busily employed earning good wages.

Mr. Thomas Lane took a somewhat prominent position in public matters. He was a justice of the peace both for the counties of Warwickshire and Worcestershire and for the borough of Birmingham, and for more than twenty years acted as an able and zealous magistrate. In addition to this he was a deputy-lieutenant of Worcestershire, a member of the Police Committee and of the Lunatic Asylum Committee, and a guardian of the Assay Office, besides being deputy-chairman of the West Suburban Railway Company. For a number of years Mr. Lane was much associated, both publicly and privately, with the late Lord Lyttelton, and a strong friendship existed between the two. Although by no means eager to make himself conspicuous, he possessed in East Worcestershire more influence, probably, than any other gentleman; and, so much was he respected by both Liberals and Conservatives, that he might, no doubt, had he chosen, have occupied a far higher position in the political world.

In 1873, Mr. Joseph Lane, the founder of the business, died, and three years later his son, Mr. Thomas Lane, of whom we have just been speaking, followed him to the grave. The varnish business was then disposed of to Messrs. Thornley & Knight, and the bullion and refinery business to Messrs. C. Harrold & Co. The gold, silver, and metal leaf, and bronze business was taken over by Messrs. Wright & Bull, of whom the former was at the time holding a most confidential position as manager in the business, and the latter had for many years held the post of traveller. Mr. Bull, we regret to say, died in 1883; but the business of gold and silver leaf making is still carried on at the old premises in Great Charles Street, Birmingham, by Mr. Samuel Wright, who, curiously enough, was born just fifty years ago, in the very year in which the Queen began to reign. As a proof of the good reputation which the Works in Great Charles Street have obtained, it may be mentioned that, among many other public buildings, the Clock Tower of the Houses of Parliament was decorated with gold leaf from that establishment. Nor must we omit to state that from the same factory comes the gold leaf which is used in the binding of the present ALBUM.

Messrs. Benton & Johnson, London.

ORIGINALLY, wire was made by beating metal into thin plates and then cutting it into strips and rounding it with a hammer. The sacerdotal dress of Aaron had interwoven shreds of gold, which were, doubtless, obtained by this process. The interweaving of gold threads into dress-stuffs is mentioned by Pliny, who ascribes the invention to King Attalus, but it was practised in Egypt and in Oriental countries before the era of that monarch. Gold wire is found attached to rings bearing the date of Osirtasen I., 1740–1696 B.C.

Many circumstances point to the conclusion that the art of weaving and embroidering with gold and silver originated in India, where it is still an important industry, and that, from one great city to another, the practice travelled westward,—Babylon, Tarsus, Bagdad, Damascus, the Islands of Cyprus and Sicily, Constantinople, and Venice, all in the process of time becoming famous centres of gold and silver lace manufacture. Agrippina, the wife of the Emperor Claudius, had a robe woven entirely of gold, and from that period downwards royal personages and high ecclesiastical dignitaries used cloth and tissues of gold and silver for their state and ceremonial robes, as well as for costly hangings and decorations.

Gold and silver wire drawing may be traced over four centuries back. It is an old trade, and Messrs. Benton & Johnson, of 63, King's Cross Road, London, are the oldest Firm in England in this branch of commerce, of which they have been a representative for about five generations. When we visited their Works, we were first shown over the shop where the silver is received in bars weighing 300 ounces—the basis of all modern gold lace, bullion, or braid being in all cases silver-gilt wire. The pure silver is first cast into ingots, and then forged to the required size before drawing. Each bar of silver we saw in this department was worth, at least, £100. Before drawing, the bar is gilt and pointed; it is then seized by tongs hooked to a shackle, and the silver is drawn by a steam winch through a plate of highly-tempered steel; the same process is repeated through another plate with a smaller aperture until it is small enough to be transferred to the workshops, where the process is carried on with great care. For drawing very fine wire, in which great uniformity is required, perforated rubies or other hard stones are fixed in the plates. The wire is constantly annealed and drawn cold. The machinery includes a draw-bench, which lifts the wire from a reel to the hole in the draw-plate, from which it passes to another reel, or drum, on which it is wound, to be again drawn through the next smaller hole in the draw-plate, and so on until it is reduced to the required size. Wax is used for lubricating.

The old drawing-machine is worked by hand, but the new contrivances employed by Messrs. Benton & Johnson are driven by a steam-engine, and the manual labour saved since the introduction of these machines would surprise the early wire-drawers if they could revisit the earth to inspect the modern processes. One ounce of silver can be drawn by this Firm into 4,000 yards of wire, and, although a rich gold colour is produced, the amount of precious metal employed for gilding one ounce of silver does not exceed five grains! Richer

qualities are made for the best military work, containing twenty grains to the ounce. A bar of silver such as we saw in the rough state, measuring one yard in length, and weighing 500 ounces, can be drawn into 2,000,000 yards of wire! When the silver-gilt wire is finished and wound on to small bobbins, it is worked up into "gold braid" by braiding-machines, bullion for epaulettes, &c., and spun upon silk for the manufacture of lace and embroideries. In Europe the demand for gold and silver lace, &c., arises in connexion with naval and military uniforms, Court costumes, public and private liveries, ecclesiastical robes and draperies, theatrical dresses, and the badges and insignia of various orders. We ought to mention that the "gold wire," before being made into thread, is flattened by passing the wire between a pair of rollers of fine polished steel.

The qualities of wire prepared by Messrs. Benton & Johnson are round wire, flat wire, thread made of flat gold wire twisted round orange-coloured silk, and bullion for fringes. They also manufacture large quantities of tinsel threads in 150 different shades of colour for art needlework and ladies' embroideries. This specialty is exported to American, Indian, and Chinese markets. They also contract for the supply of their gold and silver wires, braids, and bullion to Her Majesty's Army and Navy, as well as to the Indian Government.

In 1883, at the Calcutta Exhibition, Messrs. Benton & Johnson surprised the Hindoos, who pride themselves upon the manufacture of gold and silver fabrics, with their fine display of gold and silver thread. The writer of an article which appeared in the *British Trade Journal* of November 1, 1883, upon the exhibit of this Firm, said:—"Certainly we have seen nothing more handsome than the collection which Messrs. Benton & Johnson, of 63, King's Cross Road, London, have brought together in their very suitable case. First of all, one examines the gold wire, of which there is quite an extensive collection. There are samples of real gold wire on bobbins which average in length from 600 to 2,600 yards per ounce. This is, indeed, a degree of fineness which must be difficult to attain; but the fact seems to lose its importance when by-and-by we find another specimen of wire, silver-gilt, which measures no less than 4,000 yards, or more than 2¼ miles, to the ounce. Passing from the section devoted to gold wire, of which there are several most interesting specimens beyond those just mentioned, we come to that part of the case devoted to lamettas, from which the thread is subsequently made. The lamettas, of course, vary in quality according to the amount of gold used in their production. They are of various colours and lengths, and, while the gold lamettas are very handsome, one made of pure silver strikes the visitor as being very tastefully made. The gold threads and bullions which are manufactured from the lamettas are displayed in admirable variety in Messrs. Benton & Johnson's case. Among them are 'fire-gilt' threads on standard silver, a quality which is largely shipped to India; another quality of gold thread, of which pure silver also forms the basis, and a pure silver thread. Coming to the bullions, which are largely used for embroidery purposes, we have rough, check, and smooth, together with pearl purl, passings, and twists. One specimen of pure silver rough bullion stands out very prominently among its gilt compeers, and strikes one as being particularly handsome. Ladies may well be inclined to complain that articles of this sort should be almost completely restricted to the sons of Mars. Coming to the right-hand side of the case, the visitor finds a collection of gold leaf, so arranged in vases as to show the exact shade. Among the gold leaves shown are yellow, orange, red, and lemon. One specialty is a gold leaf which will not tarnish. However damp and dismal the climate of a particular country may be, this leaf maintains its brightness. It is made extra pure and thick for this special purpose, and is guaranteed to stand weather of the most disagreeable nature."

More than three years after the close of the Calcutta Exhibition we had an opportunity of examining some of the contents of the above-mentioned case. The finest silver-gilt wire, which resembled golden hair, had not tarnished, but looked as bright as the threads we saw in process of manufacture. Messrs. Benton & Johnson only make articles of the very best quality. The gold they use is reported as *chemically pure*; and, in spite of French and German competition, this very old Firm still enjoy the confidence of the British Government; and, by the introduction of labour-saving machinery, Messrs. Benton & Johnson are able to compete with their foreign rivals for the production of genuine gold and silver threads. They have no ambition to interfere with the manufacture of unreliable articles, preferring to maintain the reputation they have earned by the careful production of "old-fashioned gold and silver thread."

Messrs. Backes & Strauss, Limited, London.

GOLDSMITH'S work and jewellery have always held a very prominent place among the industries of Great Britain, and the Metropolis has long been the chief centre of the manufacture of high-class jewellery, and has enjoyed an enviable reputation for the best class of workmanship. To go back to the commencement of this branch of industry in London would be impossible within the narrow limits of this article, for the existence of a goldsmiths' guild dates from very early times, whilst the Goldsmiths' Company is one of the oldest in our chief city, and lays claim to having had, among its many members of mark, the first Lord Mayor of London. If space permitted, we should like to recall some of the earliest and most interesting events connected with our subject, and of which we are reminded from time to time by such occasions as that on which the Lord Mayor and civic dignitaries proceeded to Buckingham Palace to present to Her Majesty a loyal address anent the Jubilee year of her reign, taking with them, according to a time-honoured custom, the jewelled sword of pure gold, which was made by the goldsmiths of London in the time of Rufus. We shall, however, begin only with the dawn of the present century, and trace the progress of these trades from then until now, but particularly throughout the fifty years' reign of her most gracious Majesty the Queen. In doing this, it will be necessary also to see to what influence this progress is due, and, for this purpose, we have visited some of the largest and most enterprising manufacturing Firms, foremost among whom stand Messrs. Backes & Strauss, Limited, 64 & 65, Holborn Viaduct.

This Firm commenced business in 1813, and, from small beginnings, have steadily advanced until they now occupy the enviable position to which we have referred. To trace their progress is to trace the development of this industry, and no record of the growth of the jewellery trade would be complete without prominent mention of their name and their inventions.

Every one has noticed the artistic nature of most of the goods now exposed in our shop windows, how vastly superior they are in design and execution to those which found a sale fifty years ago, and how they increase in excellence from year to year. This is almost generally accepted as evidence of the improved taste of the public; but this cause is only secondary, and the real and primary cause is only made apparent when, by the courtesy of such Firms as the one under notice, we are allowed the pleasure of a visit to their premises, to inspect their factories and workshops, and see all the vast machinery put into motion by indomitable enterprise. It is indeed encouraging to find that men of business, who are frequently regarded as engaged in trade and manufacture for the sole purpose of making money, are directly responsible, in a very large measure, for the refinement of taste of the present age. It is our good fortune to live in an age in which our manufacturers are in advance of the people, and in which they not only produce articles of greater and greater artistic merit, but also set themselves deliberately to work to educate the people up to a higher standard of art. And here it may be observed, that this education is not confined to our own country, but

is carried beyond our shores to every part of the civilised world. How this most satisfactory state of affairs has been brought about deserves our attention.

It was Messrs. Backes & Strauss who first conceived the idea of introducing English-made jewellery to the Continent of Europe. Hitherto, goods of inferior manufacture had monopolised the markets in many of the principal Continental cities, but the Firm were sanguine of the ultimate success of the more artistic productions of England. Their venture proved a marked success, and to this Firm must be awarded the honour of being the pioneers of what is now an extensive trade, of opening up a new field for British commerce, and of raising the tone of the entire jewellery trade in many countries. To so great an extent has this trade developed, that the Firm found it necessary to establish branches at Paris and in

LONDON PREMISES, 64 AND 65, HOLBORN VIADUCT.

Germany; and now travellers to Paris, Berlin, Vienna, and other cities, are frequently seen admiring the display of jewellery exhibited in the shop windows of those cities, totally unconscious of the fact that the finest of the articles are of British manufacture, for it is an indisputable fact that London leads the taste in this branch of trade not only over Europe but throughout the world.

In visiting the premises we were first conducted to the factories. Here, in one department, we saw ingots and bars of gold and silver in a raw state, and the process of alloying pure gold to the 18-carat standard. Next, the metals were flattened out to the desired thickness, and this was done by the aid of large steel rollers moved by steam-power. The bars of metal are passed between these rollers, which are then pressed closer together until the metal assumes the thickness required. To the uninitiated, a visit of this kind abounds in surprises. The vast number of dies required by manufacturers whose productions are thoroughly

representative of the entire trade is astonishing, and can only be conceived by those who have seen them. They are used for the purpose of stamping out the metal to the requisite shape and size, and are in pairs, the pattern being raised on the one and sunk in the other, so that when the metal is placed between the two, and they are brought together with great force, an exact impression is produced.

One department might appropriately be termed the "Antique," for all the goods there made are copies from ancient jewellery, a few specimens of which we have shown in our sketch.

The excavations made by Dr. Schliemann in Homer's City of Troy, in Mycenæ, and throughout the Troad, are too recent to have escaped the memory of any, and the glorious results of his researches and his discoveries on the site of these ancient cities will probably live for all time. The remains of pottery, of jewellery, and of endless other relics of a bygone age unearthed by the famous excavator, have excited a deep interest in the minds of men, which fact our manufacturers were not slow to recognise. Hence they

BROOCH.

ASH TRAY.

BROOCH.

POWDER-BOX.

BRACELET.

PURSE.

made most praiseworthy and successful attempts to copy, reproduce, and adapt them to ornaments and to articles of jewellery for the adornment of the present generation. These consist of silver, but are oxydised to imitate more closely the antique specimens from which they are copied, and some of the figures are inlaid with pure gold, and bear mottoes in Greek of friendship and love; and, apart from the fact that they are wonderfully faithful reproductions, they must be acknowledged a very effective type of jewellery and a welcome addition thereto. It appears to have been the special aim of this Firm to manufacture facsimiles of every description of ancient artistic work, and thus we find specimens of old Roman, Damascene, Renaissance, Rococo, and almost every distinct type of jewellery from all countries and all ages.

Passing from this department we entered that devoted to modern silver jewellery, in which were represented the latest styles and most novel designs. It would be impossible here to describe the thousands of

different fashions in anything like detail, and we can only notice them generally. The display of exquisite floral designs in silver brooches was sufficient evidence that our leading manufacturers are making laudable efforts to place artistic jewellery within the reach of all. A peculiar feature was what is known to the trade as diamond-cut silver goods, consisting of articles of various shapes covered with studs which are cut in the same style as diamonds, the effect produced being not only brilliant but very pleasing. We have taken a sketch of one or two of the articles, which will serve better to explain the idea.

Apropos the present year of the reign of our beloved Queen, there was a very fine collection of Jubilee goods at prices which should enable all classes of Her Majesty's subjects to show their loyalty to their Sovereign.

Next we visited the workshops where the men were busily engaged in the manufacture of mourning goods in black enamel and onyx, the latter being in some instances very tastefully designed and ornamented with pearls.

Thence we came to the gold department, in which was made almost every description of gold jewellery. We were much interested in the method of producing the fine wire for filigree work. A strip of thick wire is

drawn through the holes of a steel plate, which are graduated in such a manner that ultimately the wire becomes as fine as a hair, and is then twisted into a cord for the decoration of various articles. This cord is passed on to another workman, who may be seen patiently, and with infinite care, tracing it over some intricate but beautiful pattern, and attaching it to the article by means of very minute pieces of solder. If the goods are to be engraved they are taken in hand by the engravers whose special duty it is to design and carry out this class of work, which must be done by hand and by intelligent workmen.

Another department is devoted to a specialty with this Firm. Every description of gold and diamond jewellery, consisting of pendants, lockets, and other articles, designed in the most artistic manner, with settings in the form of rosettes, ribands, &c., are constructed with minute interior mechanism, by means of which these ornaments are made to revolve, and so produce a most brilliant effect. Other articles of jewellery, such as bracelets, and even finger rings, are fitted with diminutive watches of the finest make, and present a novel but pleasing addition to the many types of jewellery.

Such articles as require to be set with diamonds or precious stones are transferred to the stone department, after having been coloured to that rich tone which is adopted for the best class of London jewellery and finds such universal favour.

The department of diamond and gem work literally baffles description; here we revel in brilliant gems of every hue. The combinations of various coloured gems in many of the articles show exceedingly good taste on the part of the designers, who really require to be artists in colour. Diamonds, rubies, sapphires, emeralds, pearls, and other stones are blended together in perfect harmony of colour and set in the most exquisite designs; the finest of Nature's productions from every part of the globe made up into diamond and gem work by the most intelligent artists of our day.

The Firm design and manufacture some fo the choicest specimens of gold and silver work in the shape of caskets, presentation swords, collars, badges, &c., for mayors, corporations, and civic bodies.

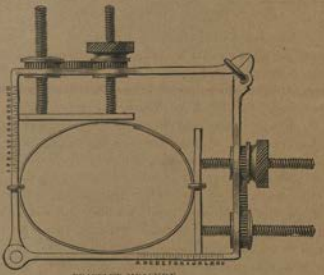
During recent years not only has Art played a conspicuous part in our jewellery manufacture, but ingenuity has also been employed to no inconsiderable extent, and wherever a want was felt it has been ultimately overcome by perseverance and invention. It will be readily understood that the bracelet offered a very wide field for these qualities. Of all articles of jewellery this was the most liable to be lost, and the most difficult to fit. Numerous inventions were brought out which, however, met with only a very small measure of success, until Messrs. Backes & Strauss conceived the idea of making a coil bracelet possessing

such elasticity as to enable it to be readily put on and taken off without the use of any snap or fastener, and, at the same time, fitting any arm to perfection. It was, indeed, to be self-adjusting, and, in the form of a snake, this bracelet became an article of great demand.

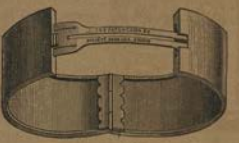
Subsequently, in May 1884, we find the *Court Journal*, the *Lady's Pictorial*, and other leading and fashionable journals, referring in terms of high praise to another invention brought out by this Firm, and having for its object the security of all classes of bracelets. The contrivance is simple, but perfect. When the snap is unfastened, there is a bolt which protects the bracelet from injury and renders its loss impossible.

It is often only when some simple but ingenious invention is brought under our notice that we begin to recognise the want of it, and wonder how we could have remained so long satisfied under the old condition of things. Until quite recently the method of measuring for a bracelet was just the same as had been handed down from generation to generation; and we must confess that, until we saw the Patent Bracelet Measure just introduced by this Firm it did not occur to us how utterly out of keeping with this nineteenth century it was to measure the arm with a piece of string or tape and forward that to the jeweller as a guide. The drawbacks of such a primitive mode of procedure are, however, strikingly apparent when we see this latest invention, which records not only the size, but also the shape of the arm as faithfully as if modelled in wax.

We were now conducted over the very fine warehouse and counting-house, and through the shipping department, in which was ample evidence that our London-made jewellery finds its way into the markets of the



BRACELET MEASURE.



PATENT SAFETY SNAP-BRACELET.

whole civilised world. And the reason of this is not far to seek. It is the result of high-class work, as well as of indefatigable labour, of boundless enterprise, and withal that strict attention to every minute detail in the business which was witnessed on all hands.

In our own country, on every side, we see the advance made in this industry in the direction of art and refinement; and in order to put the whole world in possession of these vast improvements which have taken place here, Messrs. Backes & Strauss published a catalogue containing upwards of 1,200 of the finest engravings, and compiled, printed and bound in such a manner that we can only fitly describe it as a work of art. This book was distributed among the leading houses in all countries, and has been followed up by supplements from time to time, indicative of any and every improvement or invention connected with the entire trade. These publications are naturally very much appreciated and are eagerly sought after; but since they circulate only amongst the wholesale houses, the process of educating the people up to a higher standard of artistic work might be a very slow one, were it not for the further enterprise of the Firm. Possessing some thousands of very finely engraved wood blocks and all the machinery necessary for the production of illustrated and descriptive catalogues, they undertake the entire arrangement and publication of these books for their customers in this country and in India and the Colonies. Thence they find their way to the public, and are thus the means of educating the taste up to, and promoting a trade in, a more refined and artistic style of jewellery.

It is not surprising to find that the business of this Firm increased so greatly that it was last year transferred into a Limited Company; but it is satisfactory to know that it remains under the same able and energetic management as before, the managing directors being Mr. Max Strauss and Mr. Siegfried Strauss.

Messrs. T. & J. Bragg, Birmingham.

EXQUISITE Workmanship, it has been well observed by one of our living Royal Academicians, is the essence of all Fine Art manufacture, and, above all things, of Jewellery. This axiom has been more and more taken to heart and acted upon within the last half-century, during which period there has been manifested an ever-growing desire for Jewellery that shall be chaste in design, appropriate in colouring, unobtrusive in its ornamentation, and beautiful in its general conception and effect. How great has been the advance which is marked by the Victorian Era can, perhaps, be only realised by those who are able to recall the vulgar character of the articles of personal adornment in use half a century ago. It then seemed, indeed, as if all the traditions of the earlier days of art-craftmanship had become extinct, and as if in the Goldsmiths' and Jewellery branches the death-blow had been given to original talent and manipulative skill. So far as work in the precious metals was concerned, the bullion test, if we may so term it, was at one time the all-potent factor, and, provided the article contained a given number of ounces of gold or silver, as the case might be, every other consideration—whether as to appropriateness of design or correct system of execution—was sacrificed. All this has been radically changed within the last half-century. A more cultured taste has been brought to bear upon the Jewellery Trade; designs have been greatly improved; and there is now a fixity of principles of construction and ornamentation which is becoming almost every day more general. The productions of the leading manufacturers are characterised by thoughtful arrangement and skilful execution such as have never been exceeded; and Birmingham now achieves work in the precious metals that may challenge comparison with like productions of any other city in the world.

If it be asked by what agencies this great reform has been brought about, we answer that one Firm especially has taken a leading part in this forward movement,—a Firm whose fair fame and reputation have contributed much to redeem Birmingham manufactures in the precious metals from the bad odour in which they were once universally held,—we allude to Messrs. T. & J. Bragg, of Vittoria Street, Birmingham. To trace the history of this Firm is, indeed, to compile a record of the rise and development of the artistic branch of the Goldsmiths' and Jewellers' trade in the capital of the Midlands.

The business was commenced early in the present century by Mr. Thomas Perry Bragg, who, in a small establishment in Northwood Street, by his careful and steady trading, and by the standard of excellence he introduced into the commoner class of jewellery, for which the town was then only known, he gradually raised the style and quality of his productions, and thus laid a sure foundation for the subsequent higher-class trade of the Firm.

It is a curious fact that even in those early days the manufactory was well known as an admirable school for learning the business; and it has since then been the foster-father of many who now carry on independent

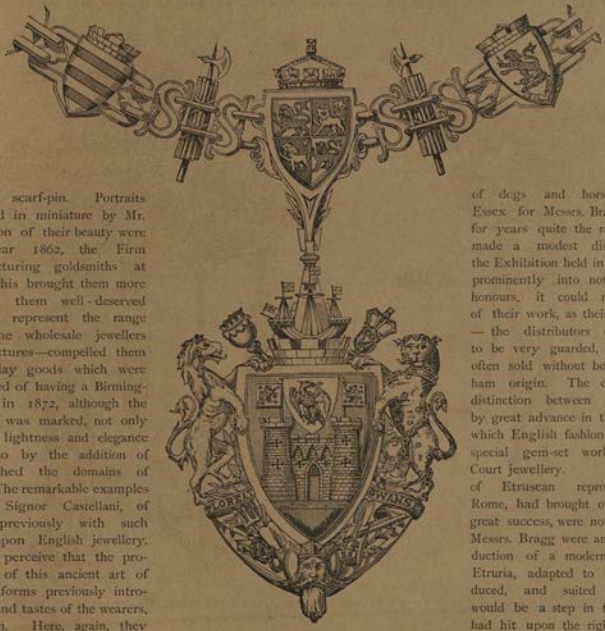
trade, and who owe much of their success not merely to the spirit of art inculcated there, but to the striving after good work and style which has always been a marked feature.

In the year 1844 Mr. T. P. Bragg retired from active work, and transferred the business to his sons, Thomas and John Bragg, who from that time carried it on under the name by which it has become so widely known. The renewed energy and enterprise infused into the concern brought it rapidly forward, and a new style and character of Goldsmiths' work came from Birmingham which had never been previously believed to exist out of London or even Paris. The Firm was looked to for taking the lead in style, and was not found wanting. The substitution of geometric and symmetrical shapes for jewellery, in place of the endless variety of

BOUQUET-HOLDER AND CHATELAINE SUPPLIED TO H.R.H. THE PRINCESS OF WALES.

unmeaning tube decoration,—of flowers and leaves so wonderfully made as to be unknown to any botanist,—this was a work needed in those days, and it was effectively performed by Messrs. Bragg. The adaptation of the then favourite turquoise, in the cluster or *pavé* setting, to this class of geometric brooch, or other personal ornament, was also due to this Firm, and proved in those days one of their most successful ventures. Strange to say, the application of enamel to jewellery, so popular in the Middle Ages, had become almost a lost art. The mere covering of spaces with enamel in certain classes of mourning jewellery certainly did exist; but the initiation of the geometric form for the ornamentation of jewellery, and its adoption as a settled fashion, suggested also the application of beautiful and appropriate surface decoration. The classic cameo could be properly adorned with borders from ancient Greek vases, and here the question of enamel immediately suggested

itself. The new system of decoration came at once into great favour: firstly, black enamel, and afterwards other colours to harmonise with the diamond, ruby, emerald, carbuncle, and amethyst. Enamel was everywhere in demand. It even became a catchword in the jewellery trade throughout England, that an article was or was not "Bragg's," according as there was or was not enamel upon it. It will be well understood, therefore, how the friendship of one member of the Firm with Mr. Essex, the eminent painter of enamel miniatures (fine specimens of whose work may be seen in South Kensington Museum), led to the painter adapting his talents to the limits



CHAIN FOR THE MAYOR OF SWANSEA.

of the scarf-pin. Portraits executed in miniature by Mr. by reason of their beauty were the year 1862, the Firm manufacturing goldsmiths at While this brought them more secured them well-deserved quately represent the range with the wholesale jewellers manufactures—compelled them to display goods which were suspected of having a Birming- similar in 1872, although the periods was marked, not only tion of lightness and elegance but also by the addition of approached the domains of

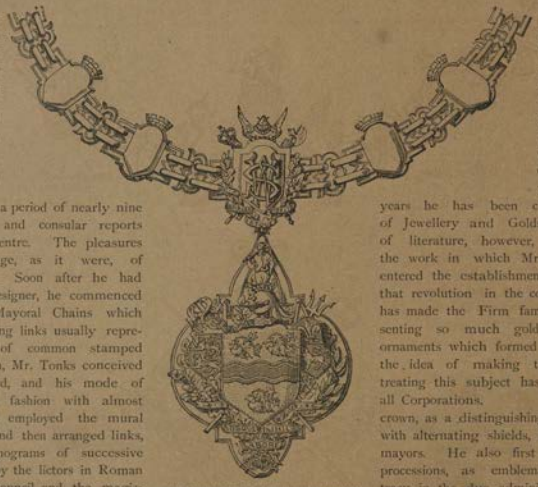
The remarkable examples which Signor Castellani, of years previously with such effect upon English jewellery. first to perceive that the pro- version of this ancient art of metric forms previously intro- wants and tastes of the wearers, direction. Here, again, they both artistically and com- of years an interesting series cord and Etruscan decoration

of dogs and horses were Essex for Messrs. Bragg, and for years quite the rage. In made a modest display as the Exhibition held in London, prominently into notice, and honours, it could not ade- of their work, as their relation — the distributors of their to be very guarded, and not often sold without being even ham origin. The case was distinction between the two by great advance in the direc- which English fashion had set, special gem-set work, which Court jewellery.

of Etruscan reproductions, Rome, had brought out a few great success, were not without Messrs. Bragg were among the duction of a modern British Etruria, adapted to the geo- duced, and suited to the would be a step in the right had hit upon the right thing, mercially, and for a number of examples of the Roman appeared in quick succession, and met with universal favour.

In 1866 Mr. J. William Tonks became associated with the business, and this marked a further advance in the artistic development of the concern. On the retirement of Mr. John Bragg, in 1877, he became a partner, and soon after the death of Mr. Thomas Bragg, in 1879, he took the responsibility of sole proprietor. He had already had an interesting literary and artistic career, and as this career has been for twenty years so closely identified with the business we are reviewing, a few brief details may not be out of place. Born in Birmingham in 1841, his art education was assured by ten years spent in the drawing and modelling

departments of Messrs. Elkington, while his record as a student of the local School of Art, from 1854 to 1863, gave promise of his future. In literature he early distinguished himself by gaining a prize of £25 for an essay on a theological subject; and as a contrast obtained, in a severe competition a few years later, a prize for a serial tale, "The Junior Clerk," which was published in the columns of the *Birmingham Weekly Post*. Apart from occasional incursions into the realms of poetry and descriptive literature, the best-known papers of Mr. Tonks have been on art topics. His addresses to the Architectural Association and other local bodies have appeared successively in the pages of the *Architect*, the *Builder*, the *Building News*, the *Artist*, the *Jeweller*, and other periodicals. We notice such subjects as "The Application of Design to Manufacture," "Interior Decoration," "Architectural Metal Work," "Colour in Architecture," "Exhibitions and Museums," and "Statues and Monuments." At the instance of the Society for the Promotion of Scientific and Artistic Industry, in conjunction with the Birmingham Chamber of Commerce, Mr. Tonks visited Vienna in 1873, and drew up a most important report on the Jewellery shown at the Exhibition there, which will be found on perusal to have antici- pated some of the movements of fashion in England in that depart- ment, if, in- deed, it has not occasioned them. His analysis of the Jewellery in the Paris Ex- hibition of 1878, which appeared in the *Jeweller*, was widely copied and cir- culated, be- cause of its direct interest to all con- nected with the trade. For a period of nearly nine years he has been chiefly looked to for trade and consular reports of Jewellery and Goldsmiths' work in his own centre. The pleasures of literature, however, have been only the fringe, as it were, of the work in which Mr. Tonks has been engaged. Soon after he had entered the establishment of Messrs. Bragg as a designer, he commenced that revolution in the conception and treatment of Mayoral Chains which has made the Firm famous. Instead of the unmeaning links usually repre- senting so much gold, or of the several rows of common stamped ornaments which formed the ordinary civic decoration, Mr. Tonks conceived the idea of making the chain an historical record, and his mode of treating this subject has now become the prevailing fashion with almost all Corporations.



CHAIN FOR THE MAYOR OF DARWEN.

He first employed the mural crown, as a distinguishing emblem of civic dignity, and then arranged links, with alternating shields, for the arms, crests, or monograms of successive mayors. He also first adopted the fasces carried by the lictors in Roman processions, as emblematic of the union of the council and the magis- tracy in the due administration of a town. So much did these ideas meet the views of Corporations, that, as an instance, in Stockport, each set of three fasces, or bundles of sticks, axe in centre, was ordered to be of the exact number of the members of the Council. These things were so simple that, as when Columbus made an egg stand on end, all could do it when they had once seen it done. But the fact that Messrs. T. & J. Bragg have now made over eighty of these Mayoral Chains, proves that the animating spirit of design is in full vigour, while the chains described give evidence that the work is making fresh artistic advances.

As an example of the foregoing definitions, we may proceed to describe shortly the Mayoral Chain of Swansea, presented by Mr. F. Ash Yeo, M.P., and illustrated on the preceding page. In general style the chain is Gothic, being formed of a series of enamelled links, doubly connected by the letters S S, which are arranged on each side with civic fasces, alternating with naval tridents. The S S link is derived from the old Lancastrian collar, and, at the same time, forms a rebus on the name of the town, in old times divided into Swen-sey. In a series of forty richly-emblazoned shields, executed in enamel, is conveyed the history of

the chief magistracy of the borough since its incorporation. Pendent to this chain—from a centre link of Gothic design, bearing upon a shield in front the arms of South Wales, and upon the reverse the bearings of the former Princes of Glamorgan, both surmounted by the jewelled coronet of the principality—is the badge itself. Its main features are the arms of Swansea, in enamel, upon a Crusader shield, having, as supporters, the golden lion of De Breos, the first Norman lord of the manor, and the silver panther of the Duke of Beaufort, the present lord. On the large shield is a mural coronet, surmounted by the lymphad or Mediæval galley, the crest of the town, with pendants, displaying the cross of St. George. On either side of these appear the heads of the two

JUBILEE CHAIN FOR CLITHEROE.

maces, placed in saltire, being exact fac-similes in miniature of those belonging to the Corporation, presented, one in silver by James I., the other by George III. in gold. The principal feature of the lower part of the badge, as regulating the form of it, is a large anchor in platinum, round which are arranged nautical emblems, oars, paddles, spars, and cordage. A head of Neptune in repoussée is introduced, with long flowing beard, and fishes issuing from it, while enamelled ribands, entwining with the trophies, bear the motto, "Floreat Swansea." The reverse of badge displays the decorative features as in front, every part being complete, except that the shield bears an inscription and the donor's name, while, amidst the wreath work, clustering round the base, is the smallest silver coin of the realm, the Victorian penny, to mark date of presentation. The alternate initial in the Darwen chain, also illustrated, forms a pleasing decorative feature, without being obtrusive, The badge, in this instance, is a very important one. The locality is indicated by the wave-lines in blue upon the shield, the heraldic description of a river, with its two tributary streams. The larger geography is shown by the arms of Lancaster and England, which the red rose of land at sides of the centre shield, The trades of the town are Lancaster further emphasises, and the coal-miner, the latter expressed by the cotton plant forming the crest of the place, while the motto, "Nothing without labour," is a hopeful one. Besides other national emblems completing the design for badge, the centre link is arranged as a trophy, with mace and fasces, bearing also crest, monogram, and motto of the first mayor.

Keys in gold and silver have also formed a very special feature of Mr. Tonks's designs,—one for Wolverhampton Park, another for the Eye Hospital, presented to Lady Leigh, and a third given to the Right Hon. John Bright, M.P., being conspicuous. Caskets have been yet another important feature of the trade, one completed for her Grace the Duchess of Sutherland being remarkable for beauty of design. As a past student

of the School of Art, Mr. Tonks displayed in the Science and Art Department of the Health Exhibition, in 1884, a series of examples, which secured him a silver medal for design, and brought him prominently into notice. A chatelaine and a bouquet-holder for H.R.H. the Princess of Wales (see illustrations); a superb key for H.R.H. the Prince of Wales; an emblematic suite of Jewellery, representing Poetry, Painting, and Sculpture, for Mrs. Dix Perkin; and a number of borough seals, were elaborate specimens. To these must be added a seal for the University College of North Wales, the steward's Jewel for the Royal Masonic Institute for Girls, the founders' Jewel for the Lodge of Prudence, Liverpool, and the pass for the Colonial and Indian Exhibition. On the introduction of Sir Philip C. Owen, the Queen, who desired a work of English design and manufacture, graciously commissioned Mr. Tonks to mount the fan for presentation to H.R.H. the Princess Beatrice on her marriage. The result gave the highest satisfaction, and letters of appointment to Her Majesty were granted to the Firm.

Perhaps we cannot better complete this notice than by a description of the Jubilee Chain for Clitheroe, one of the latest productions of Messrs. Bragg.

This special Mayoral chain and badge have been presented to the borough by Alderman William Garnett. The work is in gold of 18-carat quality, each link of the chain Hall-marked, and the badge, which is in form a Gothic quatrefoil with appropriate finials, affords in itself a summarised history of the borough. The old castle, now a weather-beaten ruin, but still an historic landmark, is indicated in the cognisance of the town as a bomb-proof fortress of the Norman period, with flying banners in its three towers, representing the cross of St. George. The descriptions of its early charters, with dates, are given in raised gold in the niches of the quatrefoil; while the arms of the town are shown in enamel on the obverse, the reverse is no less beautiful, with the enamelled inscription in various colours. The centre link is remarkable for its expression of the gift as a Jubilee memorial, but especially from the exquisitely-enamelled miniature portrait of the Queen, with the Royal supporters beside it, and surmounted by the Imperial crest. The chain is composed of a series of large links, harmonious with the Gothic spirit of the design, and united by smaller ones, with bold monograms, C. C., for the "Corporation of Clitheroe." These large links bear shields, surmounted by appropriate crowns or coronets, obverse and reverse, giving a connected history of the borough. The arms of the first Henry de Lacy, Earl of Lincoln, who granted a charter to Clitheroe, are followed by those of Edward III., confirming the same. Then come the armorial bearings of a number of kings of England in succession, up to King James I., those of the Duchy of Lancaster, of the Dukes of Buccleuch, of the Recorder, of the Braddyll, and other ancient worthies of the district; of Mr. James Garnett, J.P., the present Mayor, for the ninth time serving that honourable office; and not least those of his brother, the donor. By a happy arrangement the shields at back of the several coats of arms bear in enamel the description of the bearing on the obverse. The whole is carried out in the best style, and forms one of the most remarkable decorations which Messrs. Bragg have produced.

The Firm under notice may be said to have now reached the gamut of the Jewellers' range of Art. From the small silver brooch or gold scarf-pin to the casket,—the civic and chivalric decoration,—there is a wide stretch; and it is interesting to find, in this age of rush for making money by putting enormous quantities of ill-considered work upon the market, that Messrs. Bragg have consistently kept in view the fact that excellence of manufacture and high Art aims are, after all, the best guarantees for solid and enduring success.

Messrs. E. M. Reilly & Co., London.

EARLY in the present century, Messrs. Reilly were established near Chancery Lane in Holborn, where they enjoyed the patronage of members of the legal profession, besides an extensive country connexion. Their premises were extensive, and afforded every facility for carrying on a large business. They adhered to the principle, that "It is not sufficient that an article be cheap; it must also bear the test of excellence." The lease of these premises expired in 1847. The new road from Holborn to Oxford Street had just been opened, affording an opportunity to obtain a new building situated in a fine central position, the leading approach from the City to the extreme west end of London.

Messrs. Reilly first exhibited the now popular "Breech-loaders" in the World's Fair of 1851, but the sporting public had not then discovered the great advantages of the system. About this period or a few years later, Messrs. Reilly received favourable reports of their breech-loaders from a few unprejudiced sportsmen. Mr. Legard, of Malton, Yorkshire, after trying the new gun, wrote: "The quickness of loading is wonderful; the new gun kills as well as my old ones." Numbers of other gentlemen expressed their high approval of the new system. Gunmakers held aloof, advancing specious arguments against the adoption of the new gun, and wrote long letters, filling the columns of the *Field* with their plausible objections. At length the editor of that journal proposed a public trial to settle the serious questions which had been raised. The result came out as anticipated by Mr. Reilly and his supporters, showing no great difference in the performance of their breech-loaders and some of the most renowned muzzle-loaders, which were gathered from all quarters with a view to give a *quietus* to the new invention. After the trial the editor of the *Field* stated:—"It is impossible to ignore the merits of the breech-loader. The 16-bore sent into the contest by Mr. Reilly performed equal to the best muzzle-loaders and better than many."

Messrs. Reilly made a good show at the Paris Exhibition of 1855, and their display attracted considerable notice and valuable patronage. All the goods were sold and many orders booked.

Great preparations were made by this Firm for the London Exhibition of 1862, and about this time Mr. Edward Reilly had taken partners and extended his business to a great extent, having opened a branch house farther westward in Oxford Street, near Regent Circus, where an active trade was carried on.

At the Paris Exhibition of 1867 Messrs. Reilly were highly successful, and recognised as the leading makers to the best amateurs of the day, which led to the establishment of a branch house in the Rue Scribe, Paris. Captain James Forsyth said in the *Field* of July 6, 1867:—"The stand of arms shown by Reilly & Co., of London, is undoubtedly the best in the Exhibition. Almost every system of breech-loading that has been introduced for sporting guns and rifles is here seen, and their heavy double central-fire rifles for shells and for spherical balls are in every way excellent. This Firm is among the first to adopt and carry out

any Improvements; and they offer the advantages of working at comparatively low rates, and carrying out orders with dispatch. I can myself speak to the soundness and excellent shooting of their central-fire rifles, having used them several seasons in India, with the effect of leading me to prefer their central-fire system as now constructed." In August of the same year Captain Majendie, R.A., one of the Commissioners appointed by the British Government, wrote to the *Illustrated London News*:—"The English display of arms consists of a fine collection shown by English Government, also Messrs. Reilly's show-case is one in which the proper course has been adopted to exhibit in a worthy manner the advanced position of the English gun trade by a private firm. Messrs. Reilly have a number of sporting guns and rifles of different sorts, the best being made on the central-fire system." Messrs. Reilly were also exhibitors at the following Exhibitions:—Paris, 1878; Calcutta, 1883; and London, 1884; Gold and Silver Medals being awarded to this Firm for their improvements in sporting guns and rifles of the latest modern systems.

Pigeon shooting, from the formation of the Gun Club, Wormwood Scrubs and Hurlingham, had been growing important, attracting the most famous shots of the day. The publication of Holt's "Sporting Calendar," in April, 1882, giving tabulated reports of the shooting at the principal clubs proved the prominent position this Firm had attained. At the end of the season the Calendar gave the aggregate of winnings, of which we subjoin a statement relating to Messrs. Reilly's guns. "Season of 1882, won at the principal shooting clubs near London:—Seventeen Prize Cups, value £519; a Gold Medal, value £50; a Silver Medal and £6,148 in specie; which was nearly twice as much in prizes and specie as won by guns of any other maker." In the season of 1883 Messrs. Reilly were again very successful, and gentlemen shooting with their guns at Hurlingham and the Gun Club, won sixteen Cups, value £505, and £3,162 in specie, results which again placed them a very long way in front of other gunmakers. In the season of 1884 they headed the list of winning guns, their patrons securing thirteen Cups and £2,982, nearly £3,000 in money prizes. In 1885 they were also successful, thirteen Cups and £2,603 being the prizes won by their guns at the principal shooting clubs. The Grand Prix du Casino, the principal *objet d'art* of the International Meeting at Monaco, was won, in 1886, by Signor Guidicini, the Italian sportsman, who was second the previous season. Besides the valuable trophy, estimated at 5,000 francs, the Signor won 18,250 francs, killing nineteen birds consecutively within the limited boundary, shooting with one of Messrs. Reilly's full-choke 12-bore pigeon guns, defeating seventy-four other competitors. The remaining events of this year were not reported, but their guns were most prominently used by the principal winners.

Messrs. Reilly & Co.'s stand at the International Inventions Exhibition of 1885 was acknowledged to have been one of the best-appointed exhibits. Express rifles formed an important part in this display. The double 450-bore and 500-bore with long cartridge and 120 grains of powder, and the 400-bore with 90 grains of powder were much admired, and considered equal to the work required of them, viz., deer-stalking, black buck, &c. Amongst the exhibits were Magnum Express 577 and large bore rifles, 12, 10, 8, and 4-gauge, single and double barrelled, of the latest construction, taking heavy charges of powder, as supplied to well-known hunters and explorers in Africa, India, and other parts of the world. Rook and rabbit rifles of 300-bore, with hammers and hammerless. The shooting of these small bores—either single or double barrel—rifled on their non-fouling system, is wonderfully accurate.

The show-cases at the Inventories contained breech-loaders, both hammer-guns and hammerless, with all the modern improvements and exquisite finishing. Most of these guns were in pairs, and some few sets of three guns to match, as required by the leading sportsmen of the present day.

Great advances have been made in hammerless guns, and further modifications appear to be in view. The perfection of Anson & Deely's patent ten years ago (1877), the first hammerless gun with the top lever, surpassed all others. This gun is shown in the engraving above.

Messrs. Reilly also exhibited self-ejecting hammerless guns, which throw out the exploded cartridge-case or cases, as may be. If only one shot has been fired, only the empty case will be ejected; but if a double shot, then both empty cases will be thrown out. This gun has the automatic safety bolt, and other recent improvements in hammerless guns. One of their patterns is here shown by an engraving.

The collection included Colonial pattern guns with one barrel rifled, wild fowl guns of large calibre, and Naturalists' guns. Some of these lighter guns are also suited for ladies' or boys' use. There was likewise a fine assortment of revolvers, including the new regulation self-extracting army revolver (476 bore), taking the Government ammunition; bull dog revolvers, with smaller patterns for travelling and house protection. Other items, such as various patterns of leather gun-cases, bags, cartridge-magazines, &c., shown by the Firm at the Inventories completed the picture and helped to make up a well-appointed miniature gun-shop in the Exhibition building.

Messrs. Christy & Co., London and Stockport.

CHRISTYS! Who has not heard of Christys, the world-renowned and famous hat-manufacturers in countless shapes and materials? The name "Christys" predominates the habitable world. Their goods are to be found in every known market. North, south, east, and west, from pole to pole, in the Old World and in the New, we meet with the name. No region is too remote, no country, be it ever so inaccessible, but it is present and influential. In the palace and in Parliament, in the church and in the barrack-room, in the desert and upon the battle-field; in the bazaars of the East, from Turkey to Japan; from Norway to the Cape of Good Hope; from Canada to Chili, in Australia and in New Zealand, and in the chief cities of the Continent Christys' wares are to be found. Christys send representatives to European countries and to America, and hundreds of merchants traffic in their goods—from the cocked-hat of the general to the helmet of the private soldier; from the aristocrat among head-coverings—the silk hat, worn by prince and peer,—downwards to the cap of youth; helmets to protect our heads from the sun's rays, and fur caps to shield them from cold. Christys also cover vast numbers of our civilian army, and most of our police, both at home and abroad. Their trade-mark is registered wherever a trade-mark law is in operation; it is extensively pirated, and Christys have fought successfully several actions in order to defend their fame.

Like "Lloyds" in the shipping, "Christys," in that section of the clothing world devoted to the production of hats, has for generations been a name synonymous with the highest standard of excellence, and the traditional history of British industries has no prouder password to offer to the faith of foreign traders. As to English manufactured goods, it is something to be able to point to one sterling Firm who, through evil or good repute, has upheld an unsullied reputation, and maintained a steady increase in its departments of commerce. The passive vindication of national integrity by Firms of this character is that which carries an empire through long-continued commercial crises, and affords to trade a protection against possible disintegration. The example offered by Christys in this respect is the more splendid because it will bear the microscopic test of detailed examination in all the branches of their labours. Throughout the fifty or sixty operations to which the raw material is submitted in their factories before it is given to civilisation as the finished work of industrial art, a typical thoroughness is manifest; the serial progressions are everywhere the same, the evolution in substance and result is absolute and complete.

The textile industry to which each of us is largely indebted for multiform varieties of an article in daily use, and the lead of which Christys command, offers a subject instructive, entertaining, and full of moral reflection. To give anything closely approaching a technical description is undesirable in an article of this kind, even if the limits of space did not forbid. Our purpose is rather to suggest the leading features of a great industry than to exemplify the gradual stages of manufacture. A summary of the raw materials required in the Christy

factories may, therefore, be suitably introduced at this point, before attempting to give a brief description of the extent and ramifications of the Works themselves. For the silk principally used in the manufacture of what is known as the dress or fashionable hat, of which it is the main material, India, China, Italy, and France are all sources of supply. In like manner the various growths of cotton from the United States are heavily drawn upon. Cork is supplied by Spain; india-rubber by South America. Of shellac, which is taken from India and manipulated upon the premises, for the various purposes required in London and at Stockport, many tons are kept in stock; and other expensive materials in the shape of gums, resins, and dyes are called into use from almost every portion of the globe. Half a century ago, when the Queen ascended the throne, the value of all the hats made in Great Britain was estimated to be about three millions sterling; it would now probably reach five times that sum. In this extension of the hat trade, both at home and abroad, Christys have ever played the most conspicuous part, and the growing demands made upon their supplies may be imagined when it is stated that in the four years, 1837 to 1841, the total of hands employed at their factories in beaver and felt-hat, cloth and fur cap making were counted in hundreds, while to-day they are counted in thousands.

TRADE-MARK.

The silk-hatting, which is now exclusively confined to the Bermondsey factories, was formerly

"BODY SHOP," BERMONDSEY.

carried on jointly here and at Stockport; but when, gradually, this class of trade was in a measure superseded by that of the felt hat—"shooter," "wide-awake," *et alia*—the opportunity was taken by Christys to introduce into England machinery for felt-hat making. To the output of their Stockport factories they thereby gave a tremendous impetus, and, in fact, to the trade at large. Their Cheshire premises are now the most extensive of the kind in the world, and additions thereto have been made periodically since that date. Between 1881 and 1884, their Bermondsey factories were also enlarged, and almost entirely rebuilt, upon modern and improved plans, affording every facility in the way of light and ventilation. The London business was founded more than a century ago, and to

look through the fashion-plates produced by the Firm since 1800 up to the present time is to get an extended historical view of the freaks and vagaries of society in the matter of head-coverings; while the quaint and fanciful shapes in which our forefathers delighted are, to our present ideas, most amusingly illustrated. The grotesque formations of the antique ruffed hat and of the obsolete beaver are set forth, as well as patterns and designs affected by the West-End dandies of the Georgian era, whose tastes were mercilessly satirised by the writers of their day on the extravagances of fashion.

But first to review briefly the nature and arrangement of the London factories. The buildings occupy an area divided into two great sections by Bermondsey Street, Southwark, of which the more extensive is that lying on the eastern side of the thoroughfare. Each section is distinguishable by a tall shaft, and has its separate means of entrance and exit. Situated as the premises are in a district crowded by the architecture of commerce, and hemmed in by grimy, antiquated tenements, a full and immediate view is unobtainable;

CAP MACHINE-ROOM, BERMONDSEY.

but, proceeding systematically from one quarter to another, their spacious extent may be gradually realised. The department in which the visitor should find himself at the start is the "body-shop," where, as the name will doubtless suggest, the body of the silk hat is produced. This is generally of cotton stuff shaped round wooden blocks of the required sizes. The brims of the hats are formed of a stouter substance.

In the "crown-sewing" department a large number of women and girls are employed in well-lighted and lofty rooms. To each worker is allotted certain materials, for the care and proper treatment of which she is responsible to a forewoman. In the trimming and allied departments of London and Stockport there are two or three hundred sewing-machines, which keep hundreds of women and girls busy daily. The "finishing-shop" is the next stage to which the silk hat quickly passes. The series of operations are full of interest, because of the neatness and celerity with which the plush is treated by accomplished workmen. The neat and ingenious way in which the difficulties at the several points are overcome deserves close observation. To be properly appreciated it must be seen. By careful and continued pressing and ironing, all irregularities of surface are removed, and the silk begins to wear its permanent gloss and brilliance.

In the "shaping" department the brims of hats are subjected to an hydraulic machine, wherein first by gentle heat to soften the brim, and, secondly, by great pressure, they are curled to the fashion. Some are shaped by hand, a task requiring exceptional precision of eye and touch. The hats are now passed on to the "trimming" department. Here the trimmer first binds the brims, and afterwards makes up and fixes both lining and leather. The "luring-off" department shows another stage before the completion of the work is reached. The hat has been rapidly passing from one phase of manufacture to another, and now goes through an ordeal of brushings and polishings with a view to its final condition of elegance. Still must it pass a critical inspection, for possible defects ere it is owned to be in all things perfect, and is sent into the warehouse or despatched to its patron. Any faults, however trifling, that are discovered are removed, but if they be of a kind not easily remedied, the hat is at once expelled and condemned.

To the spacious premises comprising the "order," "stock," and "packing" rooms, with their imposing arrays and wealth of manufactured goods, all systematically arranged and classified, we can devote but a word. So unerring are the working regulations and routine of Christys' business, that a minute only is needed in which to produce

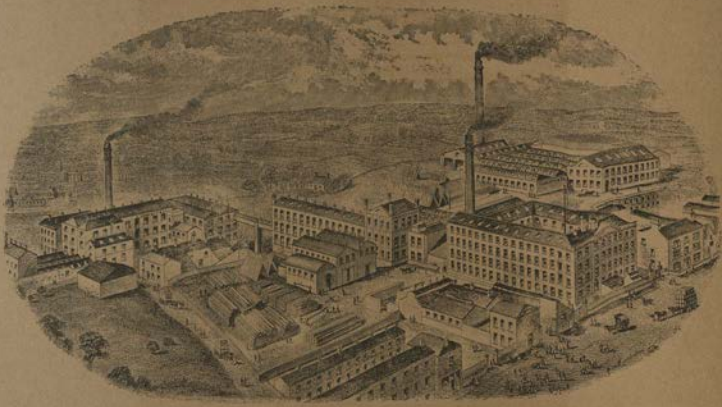
BERMONDSEY MANUFACTORY.

a certain article when called for, or to enable the heads of departments to ascertain the stock on hand of any particular make.

We now turn to the department for manufacturing caps of all kinds, railway and police caps, of strong and substantial make, embroidered smoking-caps, cricket-caps, football-caps, garden-caps, hunting, fishing and travelling-caps, polo, tricycling, and lawn-tennis caps, the Sandringham cap (as worn by the Princess of Wales); caps of every shape, shade, and colour, for every age, clime, and pursuit. In the "cap machine-room,"—see view given on preceding page—a fine apartment, about eighty feet by sixty feet, and in the adjoining rooms, were seated upwards of two hundred women and girls. With the trimmings, fancy buttons, laces, silk skeins pertaining to these caps, exposed to gaze in the rooms; and tables, counters, and shelves laden with rare and expensive materials of all sorts and hues, made up or yet to be made, an impressive idea is conveyed of the outlay of capital by the Firm, of their importance and influence as distributors of the products of manufactured industry, and as a wage-paying proprietary. To indicate the labour-saving appliances in vogue, and their value in the economy of time, one machine may be instanced for its ready and wholesale action. It is an endless steel band, the edge being a sharp knife-blade, which, driven by steam, cuts swiftly through several thicknesses of material, with the additional advantage of exactness in shape and size. Before the application of this machine

to the stuffs, the caps were cut out one by one by hand and scissors. There is also a machine which performs by one movement a similar duty, by cutting out the crowns of tweed hats and caps in large numbers.

The making of helmets, now worn by the army and navy, both at home and abroad, by the volunteers and the police, is, in its varied branches, worthy of description, but it must also be shortly passed over. This trade has grown to enormous proportions, in the mastery of which Christys have always proved equal to emergencies of large and sudden orders demanding rapid execution; but they have been compelled, from time to time, to devote more and more space, workpeople, and appliances to the proper fulfilment of contracts. The real foundation of the helmet is a cotton lining, which is drawn over a block. Layers of cork are then affixed by repeated coatings of india-rubber solution. The helmet is now ready for the outer covering of linen or cloth—used according to the needs of climate—which is solutioned to it. Finally, it passes to the finishing-room, where the various brass, bronze, and silver-plated fittings and ventilators are attached. Christys provide helmets, hats, and caps for almost every branch of the British naval and military forces, to the

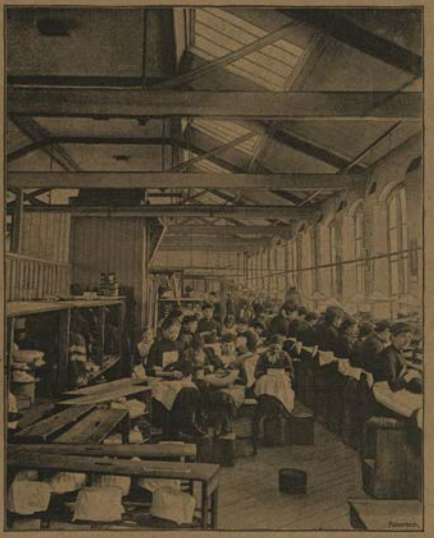


STOCKPORT MANUFACTORY.

volunteers, militia, yeomanry, Indian and colonial troops, to the City of London and Metropolitan police, and to the police of other English counties and boroughs, as well as to foreign Governments. One whole section of the Bermondsey factories is exclusively devoted to this cap, hat, and helmet making in all its intricate branches. There is a cap warehouse, or store, consisting of four large floors. The felt store is in a huge new building of five storeys, fitted with all recent improvements. The store itself is a capacious room, one hundred feet long by eighty feet wide; contiguous to this, accommodation is provided for an immense stock of straw hats of every description of manufacture. There are also extensive rooms in the basement of the main building, in which the packing, delivery, and despatch of goods is carried on. Telephonic communication is had with other large premises at the City address, 35, Gracechurch Street, where the London offices and show-rooms are situated. The bird's-eye view of the Bermondsey factories which is shown on previous page affords a graphic idea of their vast extent; but to the operations carried on within them no cursory description such as has been attempted can do justice.

In turning to take a general survey of the Stockport premises, one is impressed by the spectacle of their magnitude. It is here that the felt-hat industry is pursued on a scale of completeness and vigorous management

unparalleled elsewhere. From the moment the imported substances enter the mills, until they leave transformed into the finished requisites demanded by their consumers, there is no idea in relation to modern comfort and luxury which is not masterfully developed. The four factories of the Firm occupy a site comprising twelve acres of ground. The old premises, at the foot of a valley, were purchased early in the present century, and originally covered only 1,567 square yards. These were gradually rebuilt and enlarged, but, contrasted with the imposing mills of which they were destined to form but the nucleus, they now occupy a position of minor importance. They were once, however, the actual seat of the beaver and ruffed hat, and, subsequently, of the silk-hat making, as previously stated, and will, on this account, always remain



TRIMMING-ROOM, STOCKPORT.

historically interesting. The later buildings have, for the most part, their sites on the summit of a considerable hill, and are compactly arranged. They are divided from each other by adequate approaches, and, as in the case of the improved Bermondsey premises, covered bridges assist internal communication. Three tall chimney-stacks offer conspicuous landmarks, as viewed from the open country beyond.

Before proceeding to an inspection of the Works, it may be as well to afford some explanation of the nature of felting, for the better understanding of those processes to which reference must afterwards be made. Felting depends for its execution upon three leading principles—warmth, moisture, and friction. It is distinct from weaving, plaiting, knitting, or sewing, yet by it animal fibres are made to cohere into somewhat of the texture of cloth. An actual knowledge of the results of the felting operation was possessed in times remote

and in its practical application the monks and hermits of various nationalities were wont to work wool into a more or less compact substance, owing, it is related, to an accidental discovery made by St. Clement, afterwards fourth bishop of Rome, who is taken by hatters as their patron saint. The good St. Clement was sent on a pilgrimage by his father-confessor, and, to prevent his feet from blistering, he thoughtfully padded his sandals with wool ere setting out. At the end of his travel he observed that by heat, moisture, and pressure, the wool beneath his soles had been made into a rough kind of cloth.

After passing through the general offices at Stockport, we first entered the fur store-room—in the basement of the factory behind the offices—which contains an immense assortment of furs cut from the skin; the value of the merchandise stocked here, in countless bales and bags, amounting to thousands of pounds. Before furs for felting purposes reach the manufacturer, they are submitted to the action of nitric acid and quicksilver. This treatment, called "carroting," increases the felting property. The top storey of the same building contains the "fur-blowing" machinery in use for the finer qualities of felt hats—those made of fur only.

In a structure adjoining, the action of "fur-forming" is demonstrated, an ingenious process which may be thus described:—A cone of copper, closely perforated, slowly rotates, while under it a revolving fan exhausts the air which is drawn through the perforations. Enough fur for one hat having been fed into a cylinder, passes through a slit the same height as the revolving cone, and about an inch in width at the top and three or four inches at the bottom, in order that the base or brim may receive more of the filaments. The cone is now removed, the cap is wrapped up in a wet cloth, covered with a metal case, and put into hot water. This is known as hardening.

We now come to the operations of "fur-settling" and "planking." Whether the process be by machinery or hand, the indispensability of water, warmth, and friction is again emphasised, for they are elements in constant requisition. "Settling," as done by hand, is a course of permutations to which the conical cap is subjected by the deft fingers of the workman, who folds it triangularly over a thin wooden pin, tapering towards the ends, and presses, bends, unrolls and re-rolls it repeatedly, dipping it at intervals in hot water, until the particles of the fabric are further incorporated.

In the "milling" department, where, broadly speaking, the object is to attain by machinery—when wool is the felting substance—a result similar to that achieved by the "hand-planking," the material is placed in "fulling-machines" with the purpose of which those who have visited a woollen-mill will be acquainted. When the "planking" is ended, the cap is reduced to about half its former dimensions, but proportionately increased in thickness. It is then taken to a "stoving-room" to be dried.

Passing through other spacious premises, it is seen how the "sizing" and drying of the hats are attended to at intervals, until the "proofing-sheds" are reached, where, for hard felts, the bodies are stiffened by the application of shellac. The dyeing process comes next. In the dye-house are displayed the logwood extractors, dye-kettles, and necessary adjuncts. The dyeing being completed, the hats pass to the "blocking" department, where the body is again softened in boiling water before being placed on a hat-shaped wooden block, over which it is strained by hand or machine. After drying, the hats pass to the "pressing-room," when the first process of finishing begins. The crown to be shaped rests in an iron mould, and into it descends an india-rubber bag, which is expanded by hydraulic power. In the next stage of finishing, the hats are placed on blocks which revolve on lathes, and the surface of the felt is smoothed with emery-cloth or glass-paper. Having followed the hat through its various stages, it now enters its final—viz., "shaping" and "trimming"—as described on page 265.

The Hillgate Mill (a square red-brick building) gives general evidence of the spaciousness of Christys' Stockport premises, and, it may be mentioned, has on one side no less than seventeen windows to each of its four floors. On the top storey the brims are curled and shaped; on the third floor a large number of females are occupied at sewing machines in making linings and binding the hats; on the second, the finishing of the soft and stiffened felts is done in its many sub-divisions. Passing on, the Victoria Mill is another large building, with nineteen broad windows to each storey, and here are situated the trimmers. The printing-rooms where are the presses for printing the linings of the hats with the trade-mark of the Firm; and the trimming warehouse, stock, and trimming-cutting rooms are also in this building. Finally, we enter the shaping department, where the finishing touches are given to the hats; then follows the "luring-off" and critical examination, as described on page 265. The nobly-proportioned stock-room, extending across the first floor of the Hillgate Mill, we can do no more than mention. There are also warehouses taken up by soft and hard felts for export, and an extensive floor appropriated to home trade goods, on which is displayed a

veritable legion of hats. A large proportion of the Canal Street Works, where, in the basement, the dye-house is situated, is monopolised by a home trade warehouse and packing-rooms; and, for export purposes, a packing-room and two warehouses, the fourth floor being in possession of another army of trimmers.

Of the other buildings helping to consolidate this gigantic establishment, are the mechanics' sheds, block-turners' shops—containing the newest wood-turning machinery for making the blocks or shapes on which the hats are finished—case-makers' and carpenters' premises, timber-yards, and saw-mills, these last constantly at work in converting deals into boards for making the cases and crates necessary to the package of goods. It may be remarked that in the block-room has been kept from time immemorial a register of the shape and size of

HEAD OFFICES AND SHOW-ROOMS, GRACECHURCH STREET, LONDON.

heads of royal and titled personages. The whole of the machinery is driven by six steam-engines, which are fed by ten boilers, and a gas-engine; and it is almost needless to say that all recent improvements and inventions in hatmaking appliances are in use. To ensure a supply of pure water a well has been sunk on the premises, 242 feet deep, and capable of yielding 100,000 gallons of water daily. Last, not least, there are commodious dining-rooms for the workpeople.

Christys are hatters by appointment to the Royal Family; and among the numerous honours which have been awarded to them at various International Exhibitions, are the following:—London, 1851, medals both as exhibitors and jurors; London, 1862, medal as exhibitors, another as jurors; Paris, 1867, highest medal awarded to any hatting firm; Moscow, 1872, grand Gold Medal; Vienna, 1873, highest award; Paris, 1878, Gold Medal; Sydney, 1879; Melbourne, 1880.

Æolus Waterspray & General Ventilating Co., London.

PURE air is the food designed by Nature for the human constitution. Man may be said to subsist upon it more than upon his meat and drink, and, as if to emphasise how essential is the supply of plenty of fresh air to our physical and mental welfare, it has been pointed out that to nearly one-half of the trunk of our body is allotted the office of respiration or breathing only. But we need, perhaps, hardly enlarge upon this subject, for the importance of a practical system of ventilation has long been recognised, without the want, however, having been supplied. Such a system is undoubtedly afforded by the Æolus or Waterspray Ventilator—an apparatus as simple as it is effective; and, although invented but very few years ago, it has already been introduced in a large number of public buildings, churches, theatres, hospitals, hotels, restaurants, factories, &c., while in Germany alone more than a thousand have been fitted up in a twelvemonth. The Æolus Ventilator seems, indeed, to have solved a problem which has for ages nonplussed inventors; and architects, no less than private persons, are unanimous in their laudation as to the simple and perfect working of the system.

The Æolus Waterspray Company stands indeed in the foremost rank of Heating and Ventilating Firms. Their specialties are a system of Heating, Cooling, and Ventilation by means of a Waterspray Ventilator termed "The Æolus," and they use this apparatus as a complete inlet and exhaust system or in combination with automatic inlets or automatic outlets, as occasion may require. Their automatic outlet, known as the Invisible Roof Ventilator, is quite distinct in its action from all other automatic outlets, being dependent neither on deflected nor injected currents alone, but employing, and in a large measure relying upon, the principle of condensation and its tendency to form a vacuum for the setting up and maintenance of an exhaust action.

The Waterspray Ventilator, termed "Æolus," was originally invented and patented by Chief Councillor Kind, of Berlin, the Chief Inspector of Public Buildings under the German Government. It was improved by Mr. Heinrich Mestern, who purchased all Councillor Kind's rights, and resold them, together with his own improvements, to the Æolus Waterspray Company, Limited. On the appointment of Mr. Richard Oakley as the engineer of the Company, he added several other improvements, three descriptions of heating apparatus, and the invisible roof ventilator above named, all being inventions of his own. In March, 1884, the Æolus Waterspray Company, Limited, transferred their business to Mr. Oakley, who continued the old name, and, adding to it an electrical department, has conducted it ever since.

The Æolus Waterspray system of ventilation had, previously to its introduction in this country, achieved a high reputation in Germany, many of the most important public buildings, such as the palaces of the Emperors of Austria and Germany, and the Houses of Parliament, the Imperial War Office, German Post Office and Foreign Office at Berlin having been fitted with the apparatus. The system has, likewise, obtained a

great success in this country, and has been fitted to a long array of public and notable buildings, hospitals, churches, chapels, &c.

Some of the advantages of the system are as follows. The air of any chamber can be with certainty changed by direct influx or efflux at any desired rate by a single apparatus varying from 3,000 to 500,000 cubic feet per hour, according to the size of the apparatus used. In summer the temperature of the incoming air can be reduced as much as from 15° to 20°. In winter the temperature of the air can be raised, when the apparatus is used as a heating apparatus, to any degree desired. The air passed through the apparatus is thoroughly washed and cleansed from blacks, fog, dust, smoke, and other impurities. It is of a most agreeable and healthy character, and the degree of moisture contained in it may be regulated at will; the apparatus can be adjusted to the greatest nicety, and stopped or set going whenever desired.

Figs. 1, 2, and 3 show an upright Æolus in elevation, section, and plan. The spray is here shown sucking the air, partly from the room itself at the opening C, and again from the outside through the opening K, which is connected with the fresh-air inlet cylinder H. The air derived from these two sources is sucked through the spray, thoroughly washed and cleansed, and driven up through the outer case of the cylinder M M on plan, and so delivered into the room at the opening on top.

FIG. 1

FIG. 3

Figs. 4 shows another and more powerful class, viz., the Horseshoe Æolus. This is intended to be set in a basement, or otherwise concealed from view. The suction arm may be prolonged in any direction for the purpose of getting at fresh air, while the delivery arm may be lengthened out and subdivided to any extent for the purpose of delivery into the various rooms of the building.

Fig. 5 shows the same apparatus, with a gas heater attached, for the purpose of delivering warm fresh air for ventilating purposes.

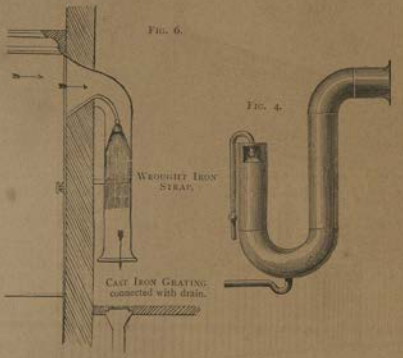
Fig. 6 is the Pendent Æolus, largely employed for exhausting vitiated air from rooms.

The system of heating on a large scale is shown by the powerful apparatus depicted in Fig. 7. Here the spray drives the moistened air into a hot chamber occupied by a coke-burning Gill stove, delivery being made through earthenware pipes into the various parts of the building.

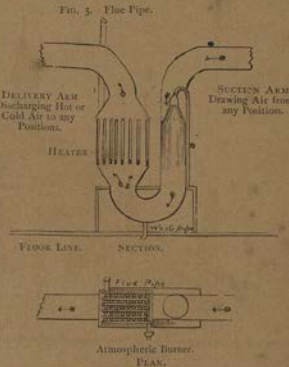
Fig. 8 shows the church of All Saints, Highgate, fitted with the Invisible Roof Ventilators, which, apart from their efficiency, have also the merit of not disfiguring the roof by the erection of excrescences on the ridge.

It will be noted that this Company has many systems, their specialty of course being the Waterspray, which they use not only for Ventilating purposes but also for Heating and Ventilation combined. A main feature of their business is the fact that they undertake and are responsible for the entire heating and ventilation. The usual practice is to employ a heating engineer to do the heating, and a ventilating engineer to do the ventilation, by which in practice it is found that each of the parties work for their own interest. The heating engineer measures up his cubical contents and his cooling surfaces, and accordingly furnishes a specification and estimate regardless of ventilation. The ventilating engineer, on the other hand, comes in and makes openings all over the place, above and below, overpowering the heating apparatus by introducing volumes of cold air and sucking out the hot air; thus, neither the heating nor ventilation are satisfactory. The estimates of this Company are viewed in the light of their combining the two departments, and they will be found to be considerably below the aggregate of others taken separately; moreover, they do what no other system of heating does, viz., they provide a complete system of cooling for summer use. The cost of the mechanical power, viz., the consumption of water, is very small; a single gallon of water with a pressure of 25 lb. to the inch, will move 1,000 cubic feet of air, and the mechanical power requires no skilled or other attention than the mere

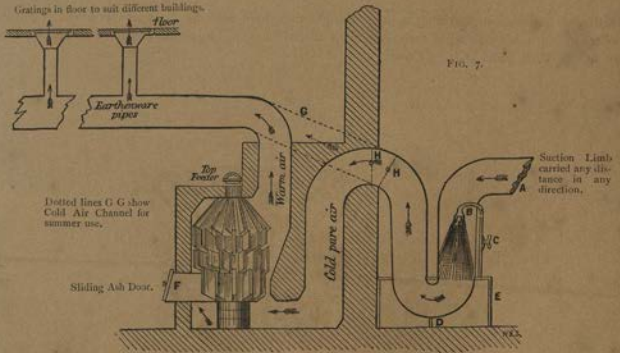
turning of a tap while the spray can be readily flushed out, should it at any time become choked by merely giving a couple of turns to the screw of which it is attached to the supply pipe. The air delivered by the Æolus is of unrivalled purity, having all been sucked in by and forced through the spray so as to



PENDENT ÆOLUS.



ÆOLUS WATERSPRAY VENTILATOR WITH SINGLE GAS HEATING APPARATUS.



IMPROVED BASE BURNER GILL STOVE AND ÆOLUS WATERSPRAY COMBINED.

eliminate all fog, blacks, smuts, and other impurities, while in connexion with the heating apparatus the particles of spray which accompany the washed air into the hot-air chamber, prevent it from becoming desiccated when brought into contact with the gills of the stove, and the oxygen is preserved There is thus a total absence of the well-known disagreeable burnt-air smell which is otherwise universal with hot-air systems.

The Company have recently removed into their present spacious premises, 124, High Holborn, where they are able to display their various apparatus in action suitable for all descriptions of buildings, whether for

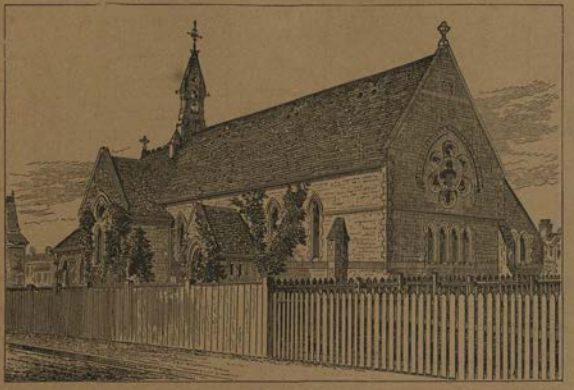


FIG. 8.—VIEW OF CHURCH WITH ÆOLUS INVISIBLE ROOF VENTILATORS FIXED IN ROOF.

heating or ventilation. Amongst other things, they have introduced a very powerful exhaust-fan, worked by electricity, in connexion with their system of electric lighting by Primary Battery. The works of the Company are at 80, York Road, King's Cross.

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Messrs. W. Richardson & Co., Darlington.

ASKED how he came to be so vigorous in his old age, Count Nesselrode, the famous Russian diplomatist, is reported to have replied that he owed it to music and flowers. This experience has doubtless been shared by others, who have, like him, felt the sanatory virtue of flowers. In modern times floriculture has thus become an all but universal passion; and among the events which have contributed towards that end, and have given a lasting stimulus to floriculture, has been rightly included the invention of horticultural buildings. The earliest record we have of greenhouses dates back three centuries, and the first one is believed to have been erected in the public gardens of Pisa. Leyden adopted the plan a few years later; and when the Earl of Danby founded the first English public garden at Oxford, in 1633, greenhouses and stoves were employed for the first time in England. Let it not be supposed, however, that the greenhouses of those days were much like ours of the present time. They were mostly lofty rooms with vertical glass fronts, and were little used at first except for the housing of orange and myrtle-trees during the winter season.

Interesting though the subject is, we must refrain from tracing in detail the further development of greenhouses. Our brief allusion to their appearance in earlier days is merely intended to throw into greater relief the truly wonderful improvements which have been made in this direction during the last two or three decades. Following the general plan of this ALBUM, we shall best accomplish the latter object by describing the Works of a Firm who, as manufacturers of horticultural buildings and hot-water engineers, have secured for themselves a notable position; we allude to Messrs. W. Richardson & Co., of the North of England Horticultural Works, Darlington.

These Works which, as will be seen from the accompanying miniature sketch, adjoin the railway, with which they are connected by a private siding, have been developed from a very small beginning to their present vast proportions. It is worthy of record that Mr. W. Richardson, who may be said to have laid the foundation of the business, still presides over it, being ably assisted by Mr. Clapham, who has also been actively connected with it for many years, and by Mr. Richardson, jun. The Works, which have been specially built for the present business, are replete with every kind of labour-saving machinery and steam tools that can be brought into requisition in the construction and fitting up of horticultural buildings and the manufacture of hot-water plant. The utmost care is taken in order to secure the best quality of every kind of material. As regards the selection of timber, for instance, one of the foremen is specially deputed to make periodical visits to the shipping ports on the north-east coast, in order to select first-hand the best descriptions. Baltic red deal and pitch pine are almost exclusively used. Having regard to the constantly varying atmospheres to which horticultural buildings are exposed, the thorough seasoning of the wood employed is a matter of great importance. The provision made for this purpose is complete, so that every

greenhouse and conservatory here constructed is well calculated to withstand all the alternations of heat and cold, wind and rain, frost, and solar as well as artificial heat.

The wood-working machinery throughout is by the best makers and of the most approved type. It includes band-saws, crosscut-saws, circular-saws, &c. The moulding machines produce work of high excellence, the surface of the four sides of the wood, which are operated upon at the same time, being as smooth as if it had been sand-papered. Timber of considerable diameter is shaped by some of the last-mentioned machines. One of them we noticed at work upon a 9-inch spout, cutting a moulding 1¼ in. deep. The spouts and sills, we should add, are made of best pitch pine. Apropos of mouldings, it will probably surprise even practical readers to learn that Messrs. Richardson & Co. manufacture no less than 300 distinct patterns, all of which are employed for horticultural buildings of various descriptions. Next we notice trying-up machines for planing and trueing surfaces. In the joinery shops on the floor above are to be found a considerable number more of steam-tools, such as drilling and mortising machines, which are fitted with improved chisels, and are so ingeniously contrived that they cut out the holes very cleanly. The tenoning machines are adapted to cut the two shoulders of different depths. There are, besides these, spindle moulding machines, framing machines for circular work, grooving machines, turning lathes, &c.

NORTH OF ENGLAND HORTICULTURAL WORKS.

In the fitting up of the joints are used, glue being altogether inapplicable for the purpose by reason of the exposure to heat and moisture. In the selection of white-lead every precaution is taken to insure that only the genuine unadulterated article is employed. Among specialties which attracted our attention was an improved sash bar so contrived as to prevent the putty from cracking and peeling off, and with an arrangement for carrying the condensed moisture inside down to the gutter. To attain this object has long been a desideratum, and the present improvement will be widely appreciated by all who contemplate the fitting-up of green-houses or conservatories. This is, however, only one of many ingenious improvements introduced by the Firm, who are the inventors and patentees of not a few others of great importance.

RANGE OF HALF-SPAN FRUIT-HOUSES, ETC., WITH CONSERVATORY IN CENTRE.

In another part of the Works we observe a steam apparatus for bending wood bars for curved domes. Among other departments, there are painting shops, glass stores, erecting and packing shops, glazing-rooms, and large stores for the various classes of ironwork, boilers, pipes, &c., employed.

This brings us to speak of the large iron fitting-shop attached to the Works, and provided with all the necessary plant, such as shearing and drilling machines, metal-turning lathes, and a variety of special tools. Here is made all the ironwork used in the construction and fitting up. The manufacture of saddle and tubular boilers for heating horticultural buildings, churches, chapels, schools, mansions, and public buildings constitutes another leading branch of the business. Many of these boilers embody important improvements made by the Firm, and secured to them by patent rights. The object aimed at is effective heating at an economical consumption of fuel;

Allusion has been already made to some of the Firm's specialties; but not to their greenhouses and conservatories, as a whole. On this and the preceding page we illustrate two examples of such work. Both designs are of excellent proportions and tastefully carried out, and the treatment from the architectural, as well as the floricultural point of view, is of the happiest character. It is in this direction, indeed, that Messrs. Richardson & Co. stand out prominently; they bring taste and judgment to bear upon their work. They are not so wedded to traditional designs as to insist upon always repeating the same stereotyped patterns; on the contrary, adapting themselves to ever-varying requirements of their patrons, all their conservatories and greenhouses are thoughtfully planned and properly built; while, moreover, great attention is paid to their effective ventilation—a point of importance which is too often overlooked. The variety of charming designs made by the Firm, as figured in their Illustrated Catalogue, is incredibly large; but, in

CONSERVATORY OR WINTER GARDEN.

addition to these, they also undertake the construction of such buildings according to architects' and other special plans.

Catering for all classes, the Firm, besides supplying horticultural buildings, also make "Cottage" plant frames, improved portable garden frames, as well as all kinds of accessories, and have the agency for the well-known Parisian Greenhouse Blinds, to which no less than forty Prize Medals have been awarded. The export trade forms an important branch of the business; and horticultural buildings intended for shipping are constructed in a portable form.

It is needless for us to say a word as to the quality of the work. The hundreds of testimonials received by them within the last few years, from clients representative of all ranks and classes, are unanimous in expressing their approval. Similar testimony is borne by the fact that, during last year alone (1886), no less than six Prize Medals and seven Certificates of Merit were awarded for the Firm's productions.

Messrs. Tangyes Limited, Birmingham.

UNDER the general title of Hydraulic Engineering are comprehended a great variety of distinct, though inter-related, branches of manufacture. So complicated, moreover, are the objects with which the hydraulic engineer has to deal, that there is hardly a branch of the applied sciences which he may not at some time or other be obliged to enlist in his service. There is, indeed, scarcely a limit to the long range of subjects that come legitimately within his province. If we bear this fact in mind, it becomes difficult to realise that this department of industry has been developed into a leading branch of manufacture only within the last thirty years. Such, however, is the fact, for it was in the year 1855 that Messrs. Tangye Brothers established the Cornwall Works, Soho, Birmingham, and it is at these Works that the art of Hydraulic Engineering has been developed into a science, and brought to a degree of perfection that was, until very lately, considered outside the range of human possibilities.

The Cornwall Works are, in themselves, a sight which it is not easy to equal. They cover twenty acres of ground, and give employment to 2,000 persons. It will thus be believed that, to a stranger, the whole factory appears at first glance like a maze, in which it is difficult to trace one's way. On initiation it becomes however, apparent that the whole has been systematically planned with the great object of simplifying the almost endless manufacturing processes which are carried on. A visit to the Cornwall Works gives one an excellent idea of the diversity of the hydraulic, steam, and other tools that have formed so important a factor in our national progress during the present century. Without tiring the reader with a long catalogue, we will just say that the Works are capable of turning out per month 40 steam-boilers, 200 steam-pumping engines, and 100 other steam-engines, 800 cranes, crabs, and lifting apparatus, 300 hydraulic presses, lifts, and jacks, 5,000 sets of pulley-blocks, and 1,000 gas-retort mouthpieces and lids. To Archimedes is attributed the apothegm,—"Give me a lever long enough, and a prop strong enough, and with my own weight I will move the world." Practically impossible as such an imaginary feat is, in our own day there has been achieved what is of far greater practical value and useful service to mankind. Let any one try and realise the amount of Power the foregoing data imply! Why, when Her Majesty ascended the throne, the total number of steam-engines at work in Birmingham was less than 240. What a contrast this affords when compared with the formidable array of totals given above as the monthly output of Messrs. Tangyes' manufactory alone!

The Cornwall Works are divided into distinct departments, each known by its letter, as A, B, &c., according to the class of machinery produced; and well-nigh the whole alphabet is thus pressed into service. To describe all the multifarious operations to be seen is more than we can undertake. We must content ourselves by saying that almost every process connected with iron-founding, steel-casting, engineering, and machine-building is carried on here on a very large scale. The endless range of iron-working tools, and the plant generally, are the best that human ingenuity has yet contrived. Steam-power and labour-saving tools are

everywhere brought into requisition, and manual labour is employed almost exclusively to direct and control; in other words, to think rather than to waste muscular exertion in mere drudgery.

Broadly divided, Messrs Tangyes' productions may be grouped into eleven different classes; and the enumeration of these will convey some idea of the diversity and scope of the machinery manufactured. The eleven classes are as follow:—1. Hand and Steam Lifting machinery. 2. Hydraulic machinery. 3. Hydraulic and Screw Presses. 4. Steam-engines and Boilers. 5. Steam Pumps and Compound Pumping Engines. 6. Other Pumps and Pumping machinery. 7. Engineering and other tools. 8. Engineers' and Railway requisites. 9. Steam and Boiler Fittings. 10. Agricultural and Colonial machinery. 11. Specialties for Gas Works. From this enumeration it will be seen how futile it would be for us to attempt a description, even if only of typical examples, of each class of machinery here produced. We might, indeed, fill the whole "Album of Arts and

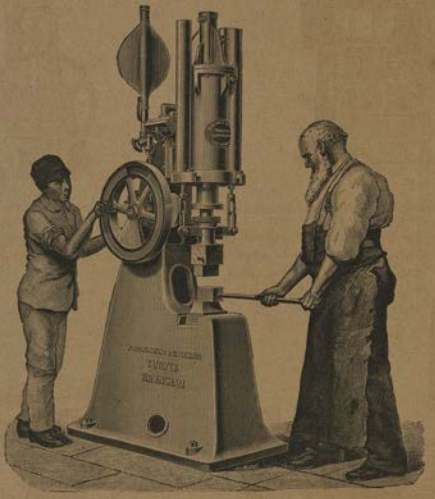


FIG. 1.

Industries" without exhausting the subject, since the Firm's own Catalogue is a handsome volume of several hundred pages. It will, therefore, be a better plan, and more conducive to an intelligent apprehension of the Firm's specialties, if we select just two or three of their steam tools for both illustration and description.

From among recent patented inventions we select the Gas Hammer, as marking quite a new departure in this description of appliance. Its general character will be seen from the accompanying illustration (Fig. 1), and having gas for its motive power, it will prove of special value in factories where an ordinary steam-boiler cannot be placed by reason of want of space. Apart from this, the Gas Hammer is far more economical in its working than the customary steam hammer, since, as in the case of gas-engines, the motive power need only be turned on when required, and may be as readily turned off when done with. The cylinder has two pistons, the under one being attached to the hammer-head, while the upper one draws in the gas and air by which the explosion is effected which sets the hammer in motion. As in the steam hammer with which we are all familiar, the

degree of force is under perfect control, and can be adjusted to a nicety. The invaluable nature of this new tool for smiths' and forging shops, as well as for other works, will be readily seen.

A different type of machine is shown in Fig. 2, which represents an Improved Geared Hydraulic Pressure Pump, specially designed and supplied to Her Majesty's Government. These pumps, which are substantially constructed, and made of the best materials, are capable, against a pressure of two tons per square inch, of throwing up 120 gallons per hour; while, if worked against a pressure of fifteen hundredweight per square inch, their pumping capacity is increased to 370 gallons per hour.

FIG. 2.

FIG. 3.

Steam-engines are made by the Firm under notice in a puzzlingly large variety. We have chosen for illustration, one which has been specially contrived for workshops where space is limited (Fig. 3). It is known as Tangyes' Vertical Engine, and is made in sizes of from four to fourteen horse-power. The standard and bed-plate are cast in one piece, thus insuring great strength and rigidity Being, moreover, self-contained, it

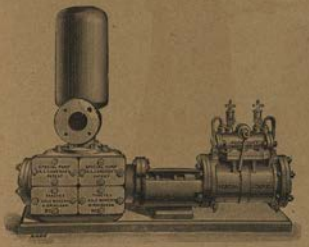


FIG. 4.

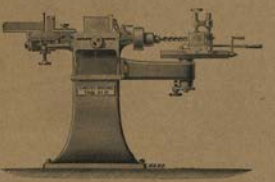


FIG 5.

requires no skilled labour in fixing. We also show (Fig. 4) an illustration of their celebrated "Special" Steam Pump, of which over 15,000 have been made and sold, and are now working in all parts of the world.

Portable and steam fire-engines are also made at the Cornwall Works, as well as boring tools, portable irrigators, and centrifugal pumps. Of engineering tools and woodworking machinery, again, there is a very large selection, including slide, surfacing, and screw-cutting lathes, bolt-screwing and nut-tapping machines, chasing lathes, and drilling and boring machines. Out of this section we illustrate a new Patent Combination Machine (Fig. 5). The wide usefulness of the apparatus to all workers in wood, will be seen from the fact that it is adapted for planing, rip-sawing, cross-cutting, moulding, grooving, rebating, squaring, bevelling, tenoning, mortising, and boring.

Agricultural machinery, and appliances particularly adapted for colonists, form yet two other important branches of the Firm's business. This section includes flour-mills, reaping-machines, corn-grinding mills, chaff-cutting machines, bone-grinding mills, indigo-preparing machinery and plant, weighing machines, patent portable gas-making apparatus, and even the construction of iron factories and warehouses.

The foregoing is at best a mere outline of the business carried on. Its enormous growth induced Messrs. Tangye a few years ago to convert it into a Limited Liability Company, while they, however, continue to hold a principal interest in the firm of "Tangyes Limited," under which name it is now carried on. Mr. Richard Tangye is the Chairman, and Mr. George Tangye the Deputy-Chairman of the Company. Rich as are our Industrial Annals in names of men who have by dint of perseverance built up successful businesses, we doubt whether there is another instance upon record of a gigantic concern like the Cornwall Works having been developed from a small factory within a span of less than one generation. Even during the last twenty years, the concern has expanded to probably ten times its former proportions, and Messrs. Tangye, the founders, have lived to see that the pains, the thought, the industry, the ability, and other talents which they expended upon their business, have brought forth fruit to their lasting credit. Indeed, their name and fame have spread throughout the world, and from east to west, from north to south, all machinery bearing the legend "Tangyes, Limited," is held in deserved reputation.

It is worthy of mention that the Cornwall Works are characterised by other distinguishing features besides their size and the number of persons employed. Messrs. Tangyes have ever realised the responsibilities which attach to large employers of labour. They have set on foot various agencies for the promotion of technical education among their working staff. They have also established, in connexion with their works, funds for the relief of the sick or injured, and have similarly provided for the widows and orphans of men who have been in the Firm's service. In the Works themselves every arrangement has been made that can conduce to the comfort and welfare of their large staff. More than this, however, substantial monetary premiums are distributed among those who distinguish themselves by talent, energy, or labour.

In other directions, too, Messrs. Tangyes have shown themselves equally generous. With a munificence truly royal, they have given a sum of £11,000 to the Birmingham School of Art, and a further sum of £10,000 to the local Art Gallery, which latter has been, moreover, enriched by them with a splendid collection of Wedgwood ware. Many other deeds of liberality might be recorded, but these two instances will suffice to show the noble-hearted generosity of the brothers, and to illustrate the text that "the liberal deviseth liberal things."

Gifted with a rare insight as to the requirements of special industries, and endowed with that indomitable perseverance which conquers all things, while at the same time possessing a highly inventive faculty, the Messrs. Tangye have built up a business which will be a lasting monument to their enterprise. In addition to their works at Birmingham, they have branch establishments in London, Newcastle, Manchester, Glasgow, Paris, Sydney, and Melbourne. In each of these, and especially in the London Show-rooms in Queen Victoria Street, will be found a display of the most varied and ingeniously-contrived machines. All of them are alike conspicuous for excellent workmanship and a high degree of finish. These two points have been uniformly recognised at all the International and other Exhibitions at which their machinery has been shown, and within the last twenty years no fewer than Thirty-six Gold and other Prize Medals have been awarded to the Firm.

To sum up, Messrs. Tangyes' Works once more illustrate forcibly that the present is the Age of Machinery, and that some of the best faculties of mankind continue to be devoted to the solution of the problem of how best to adapt means to ends.

The St. Pancras Iron-Work Company, London.

NEVER, probably, since the world began, has a larger proportion of the articles manufactured by man been composed of iron than at the present day; and, as a result of the variety of purposes to which this metal is applied, nothing is more natural than for a firm of iron-workers to make a specialty of certain branches of their trade. The well-known St. Pancras Iron-Work Company, whose premises are situated in St. Pancras Road, London, while conducting at the same time an extensive general business, have taken up among other things the manufacture of stable fittings of every description as a specialty, and undertake the entire work of fitting up stables of any size and in any style. Iron is particularly suitable, from a sanitary point of view, for this purpose; and the Company have earned an enviable reputation by introducing a much-needed system of sanitary reform into the construction of stables in this country. Guided by the advice of eminent specialists, they have given the most careful attention not only to the manufacture of iron stable fittings, but also to the paving, draining, and ventilating of the stable; and as promoters of the health, comfort, and welfare of the dumb animals whom man has sentenced to a life of servitude, deserve the good wishes of every humane person.

In addition to the many English gentlemen who have entrusted the fitting up of their stables to the St. Pancras Iron-Work Company, several foreign princes have given substantial proof of their appreciation of the efforts which the Company have made to improve the sanitary condition of the horse. The magnificent stables erected for His Highness the late Viceroy of Egypt, of which we give both an interior and an exterior view, were the subject of a beautifully illustrated article which appeared in the *Builder* of March 11, 1871. They were built to accommodate a hundred horses, and consisted of stalls and loose boxes, ample in size, and provided with every requisite for the comfort and safety of the inmates. Harness-rooms and a farrier's forge were attached. As an example of more recent work, however, which the Company have done, we may refer to the stables fitted up a few months since at the new National Agricultural Hall at Kensington, the Olympia, of which also we give an illustration. The extensive range of stabling here erected for the Paris Hippodrome afforded accommodation to about two hundred horses, and was entirely constructed and set up in the amazingly short time of six weeks. Attempts have often been made to erect portable stabling, but, as a rule, without very satisfactory results. But the difficulties in the way of attaining this desirable end have been completely overcome by the St. Pancras Iron-Work Company, who are able to combine portability with absolute rigidity in the construction of their stables. The stalls erected at the Olympia were on the portable principle, and not only could be converted with the greatest ease into loose boxes, but could be altogether removed in a short time. Since the Hippodrome left the Hall they have been taken down in order that more space may be allowed for other purposes, but can quickly be replaced when occasion arises. To make special mention of all the distinguished individuals, great corporations, and wealthy companies for whom orders have

been executed at the premises in St. Pancras Road would be a lengthy and profitless task; suffice it to say that the work of the Company may be seen in establishments of every grade throughout the kingdom, from Windsor Castle downwards, as well as in many a great establishment abroad, as before stated.

Numerous valuable inventions in connexion with stable and harness-room fittings have been brought out and patented by the Company under notice, although the demand for their goods is such that they are able to sell their patent articles at prices which compare favourably with those of many inferior productions. All the latest improvements are on view in a stable which has been built as a show-room on the ground-floor of the premises; and the patent manger fittings, with patent radial hayrack for preventing waste, are specially worthy of attention. The rack, which secures to the horse ease in feeding and perfect freedom from danger, at the same time that it economises hay, can very readily be filled, and is an immense improvement on older arrangements. Many varieties of manger are manufactured at the Works, all of which, however, are of the strongest make, and some are furnished with water-troughs and supply and waste taps. Different styles of manger are necessary—or, at all events, desirable—for horses employed in different kinds of work; and all these

STABLES AT OLYMPIA.

differences are carefully studied by the Company. Thus, one pattern is supplied to the War Office and the Police, and quite another for the horses kept by the Corporation of London; and even the country brewers and the London brewers have each their distinctive type of manger for the horses they employ. A manger composed of wrought Bessemer steel is on view in one of the show-rooms above the ground-floor.

A great mistake is committed when a stable is paved in the old-fashioned way with bricks, which seem specially designed to check the drainage and retain the dirt. The patent solid, impervious brick paving of the St. Pancras Iron-Work Company is an immense improvement on the old chequer blue brick; it is made in such a way that the draining grooves all run in the same direction instead of crossing one another, and a single sweep of the broom removes all refuse. These patent paving bricks are manufactured expressly for the Company, who make their own moulds; they have been used for many years in the royal stables, where they have been found more durable than any others previously used. In connexion with the paving-bricks we must mention the gutters also, which are made either with a movable cover or open, but always of wrought-iron instead of cast-iron. The advantage of using wrought-iron is that the gutters gain in strength and straightness,

INTERIOR VIEW OF A STABLE ERECTED FOR H.H. THE LATE VICEROY OF EGYPT.

EXTERIOR VIEW OF STABLE FOR H.H. THE LATE VICEROY OF EGYPT.

and have fewer joints to render the drainage defective and retain the dirt. The Company's patent syphon drain-pot, also, is a great improvement on those in ordinary use.

Many varieties of stall divisions, both plain and ornamental, are manufactured at the Works; but especially we must notice those which are made of wrought-iron. These are by no means simple things to turn out, although the St. Pancras Company, by means of the inventions which they have patented, are now able to make them with comparative ease. Indeed, there is no article on the whole list of stable fittings which the Company do not make of wrought-iron if required to do so. For export, these divisions are much superior to those made of cast-iron, since there is no danger of breaking, and the rails can be shipped in bundles at a reduced rate. The principal object, however, in the manufacture of these wrought-iron partitions is to avoid all angular projections against which a horse might possibly injure itself. Another point, also, about the stalls which deserves to be noticed is the safety barrier bar, which draws out on the principle of the telescope, and is frequently found extremely convenient.

The walls in the stable show-room are, for the most part, lined with glazed or semi-glazed tiles, which give to the place not only neatness but also a look of scrupulous cleanliness. The Company's special semi-glazed tiles are recommended in preference to the ordinary ones, as they only partially reflect the light, and, therefore, cannot be productive of injury to the eyesight of the horse.

Of the numerous other fittings and appliances for the stable and harness-room which are made at these Works, many of them under patents belonging to the Company, we can but briefly mention a few. The patent safety noiseless stall-tying for securing the horse to its manger, is a useful article, as also is the new pattern, registered, saddle and harness bracket. A combined grate and boiler also is made specially for the harness-room, and is carefully designed with a view to meet every want that is likely to be felt there. Besides these, all kinds of stable and harness room sundries are manufactured in the most improved styles, such as cleaning-hooks, name-plates, girth-driers, head-stall fastenings, wrought-iron ventilators, bolts, handles, and hinges for doors, locks, latches, horse-measuring standards, &c.

As we intimated before, however, the St. Pancras Iron-Works are by no means exclusively occupied in producing the class of goods above described. The Company have given much attention to the manufacture of sanitary cow-house and piggery fittings, and not long since supplied cow-house fittings to the Duke of Bedford's model farm at Woburn. They have also made specialties of iron roofing and of iron staircases, the latter of which they manufacture in every variety of style, from the simplest and cheapest to the most elaborate and ornamental. Splendid specimens of staircases may be seen in their show-rooms, and in many west-end shops; and others have been supplied by them to Windsor Castle and to the War Office. Many of their designs are extremely tasteful; but architects and builders can furnish their own drawings if they think proper. Ornamental cast-iron work, iron fencing, iron railings, and also ornamental wrought-iron work, done entirely with the hammer, are a few among the many different classes of goods produced at the St. Pancras Iron-Works. All the articles manufactured here are of the highest class, the materials used being exclusively of the best. The spacious Works are fitted with the most improved machinery, and the facility thus gained for promptly executing the largest orders is, no doubt, largely accountable for the high position which the Company have held in the trade for the last forty years.

Messrs. G. E. Walton & Co., Limited, Birmingham.

JEWELLERY and ornament for the person have long held a very prominent position among the industries of Birmingham, and whatever prejudice may at one time have warped public opinion, it is now almost universally acknowledged that much of the work of this description produced in the metropolis of the Midlands, is excellent and unexceptionable alike for design and workmanship. In the modern productions there is an absence of those obtrusive and inappropriate details in the ornamentation which were at one time too common. Thoughtful arrangement and skilful handicraft combine to produce articles chaste in outline, harmonious in colouring, and pleasing in appearance. In this branch of industry, as in many others, the year 1837 formed as it were a landmark, and it is during the half-century which has since elapsed that the local trade has made marvellous strides of progress. The scale on which the manufacture of gold and silversmith's work is now carried on in Birmingham may be inferred approximately from the fact that bullion to the value of about £1,100,000 is annually thus used there.

The jewellery trade is subdivided into several branches, each of a distinctive character, and the object of the present article is to direct attention to the productions of a Firm connected with the Fancy branch. The business of Messrs. G. E. Walton & Co., Limited, of 52, Hylton Street, Birmingham, has been established over forty years. Like many if not most of the successful concerns, it had a small beginning, having been founded by the late Mr. G. E. Walton. In consequence of the ever-increasing requirements of the business and its growing expansion, it was a few years ago converted into a private limited liability Company under the managing directorship of F. A. Walton and William Pearce, under whose joint energetic administration it has developed by rapid strides into the largest concern of its kind in Great Britain, if not in the whole world. The Firm devote their attention exclusively to the manufacture of fancy jewellery; and they produce a large variety of patented articles to which fuller reference will be made later on.

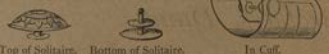
The factory in Hylton Street was specially built a few years ago, and consists of lofty, light, and well-ventilated rooms, in which provision is made not only for the carrying on of the business, but also for the convenience and comfort of the 300 workpeople employed. All the different manufacturing processes can be witnessed here, and in one large and airy apartment may be seen some 150 hands busily engaged in the various delicate operations connected with the manufacture of the goods mentioned. Another shop is set apart for hand-engraving, and long rows of men and boys are thus at work, producing chaste designs on gold and silver surfaces; while in an adjoining room embossing or chasing is carried on—an art the application of which to jewellery Messrs. Walton & Co. have done much to bring again into popular favour.

Passing on from generalities to some of the Firm's specialties, we may first draw attention to their Chain department, where gold and silver chains are annually produced by the thousand, in exquisite design, and of perfect workmanship. In ladies' chains especially many beautiful patterns are produced. It is

interesting to notice how neatly these chains are put together, and the deftness of hand with which the thousands of distinct pieces of gold and silver are manipulated by the employés; and the observer cannot help wondering at the same time at the moderate price at which these goods are placed upon the market.

West's Patent Solitaire is a specialty, the value of which has been attested by the world-wide demand with which it has met. It is made in two pieces, and is intended to facilitate the adjusting and removing of solitaires. The use of the old one-piece button, as is well-known, tears the button-holes, while at the same time its insertion or removal tries the temper of the wearer. Its simplicity and usefulness have insured for this patent solitaire an incredibly large demand, and its sale we are assured has already realised half a million sterling. It is made in an endless variety of patterns, and is uniformly of the best workmanship. Another type of solitaire is the "Safety," made in two parts, each of which remains in the cuff, and need not be removed until the garment is done with. The Patent Bi-climax One-part Solitaire is yet another ingenious contrivance of a similar nature. Its simple

FIG. 1. WEST'S PATENT SOLITAIRE.



Top of Solitaire. Bottom of Solitaire. In Cuff.

FIG. 2. PATENT "SAFETY" SOLITAIRE.

FIG. 3. PATENT BI-CLIMAX ONE-PART SOLITAIRE.

mechanism and general character may be judged from Fig. 3. There are a number of other types of solitaires and from the diversity of patterns available one would be justified in drawing the inference that the Firm in question must enjoy well-nigh a monopoly in this branch of trade.

Messrs. Walton & Co. are the English licensed makers of Birch's American Patent Watch-key, as shown in Fig. 4, which will wind up any watch, no matter what the size of the square. An equally useful little contrivance is illustrated in Fig. 5, and known as the Patent Thief-Catcher. This simple appliance has been found to answer admirably, and has repeatedly prevented watches from being stolen out of the wearer's pocket. It has moreover been highly commended by many members of the Detective force, as well as private persons.

FIG. 4. PATENT WATCH-KEY.

From a different class of goods we may single out for mention a Self-Acting Patent Scarf-Slide or Ring,

FIG. 5. PATENT THIEF-CATCHER.

Open. Closed.

FIG. 6. PATENT FLEXIBLE SCARF RING.

a representation of which is given in Fig. 6. In this the customary spikes, or pins, are dispensed with, so that no damage can be done to the scarf, which is, moreover, held firmly together without the least trouble.

All these patented articles are proving so generally useful, that the demand for them reaches annually an almost fabulous number. There are many other valuable contrivances manufactured by the Firm under notice and an inspection of their pattern-book or show-room is necessary to an intelligent appreciation of the diversity of their productions in fancy jewellery.

We believe that the Firm are ever ready to afford facilities to visitors who may be desirous to see the various processes of manufacture as carried on in their Works, and of gaining a general insight into the manner the many useful, ingenious, and elegant articles here made are produced.

By keeping abreast of the times, by catering successfully for existing demands before the public itself has realised them, and by not despising the day of small things, Messrs. Walton & Co. have built up their present flourishing business.

Messrs. Cox Brothers, Dundee.

DUNDEE, the principal seat of the Jute industry, is picturesquely situated in the south of the county of Forfar, on the left bank of the estuary of the River Tay, about ten miles from the German Ocean. Its population is now estimated at 156,000. Spinning and weaving vegetable fibres, with their related industries, have occupied the inhabitants of the town and district for centuries, and the introduction and successful pursuit of the Jute trade since the year 1822 have raised it to the position of the third town in Scotland in point of population, and the second in commercial importance. Shipbuilding and engineering in all their branches have been added to its avocations, while the railway bridge across the Tay—an important link in the direct East Coast route from London to Aberdeen—is almost completed, and forms one of the greatest engineering feats in the world. Its street architecture and public buildings keep pace with its commercial progress. The intellectual wants of the community are supplied by all the usual agencies, and its picture gallery, free library, University College, noble infirmary, and forthcoming technical and medical schools, are evidences alike of the public spirit of its inhabitants and the princely munificence of its leading citizens. The public parks at the eastern and western extremities of the town are second to none in the kingdom for beauty of situation and effective landscape gardening, while the esplanade or public promenade along the river side is an inestimable boon to the denizens of the central parts of the town.

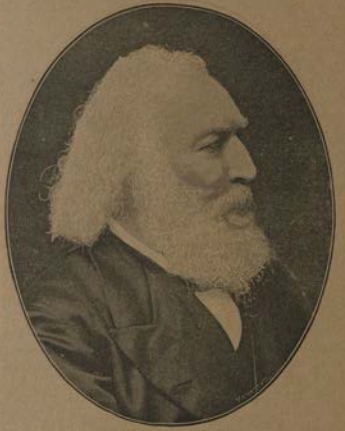
Among the notabilities to whom Dundee largely owes its present position are the Messrs. Cox, whose Works form the subject of this sketch. The connexion of the family with the textile industries of Dundee goes far back into the eighteenth century, and the four brothers who founded and developed their business into its present colossal proportions were quick to discern the capabilities of the new fibre. Accordingly, about 1849, near the site of the Works of a previous generation, the present mills were projected, and have since grown into the largest Jute factory in the world. The Works are situated on the east side of Lochee, a large village now incorporated with the municipality of Dundee, and the name "Camperdown" Jute Works was adopted in honour of the Earls of Camperdown, whose country seat is in the vicinity, and whose title was derived from the decisive victory gained over the Dutch fleet off Camperdown, in 1797, by their ancestor, Admiral Duncan; but the consideration that this victory greatly contributed to prevent Napoleon from attacking India, renders the name peculiarly appropriate.

The whole premises cover an area of twenty-eight acres, and are built in a most substantial manner of blocks of hewn squared freestones, quarried on the property and the immediate neighbourhood. The arrangement of the Works is so skilfully contrived that the various processes regularly succeed each other without the least obstruction, loss of time, or unnecessary labour. Every precaution is taken against fire, and the ventilating and other sanitary appliances are of the most scientific and modern description.

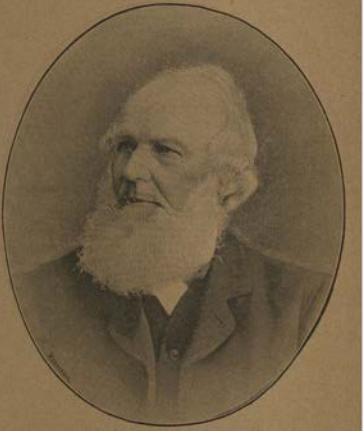
The Works are entered by a branch line off the Caledonian Railway, whose wagons convey the jute, coal,

and other materials to their immediate destinations. The coals are tipped from the railway wagons beside the furnaces, which are connected with the thirty-six two-flued boilers of the Works. The steam is conveyed by mains thickly coated with non-conducting material, passing along, well buried under the streets or avenues, to the engines, which are in separate parts of the Works, and aggregate over 4,000 indicated horse-power. The consumption of fuel, even with all modern improvements, is 90 tons a day, and all this expenditure of force demands the guidance and co-operation of an army of 5,000 employés. Although smoke is consumed as far as yet possible, the residue and noxious gases are carried off by a highly ornamental chimney-stalk 300 ft. high, built of red and white brick and stone, which cost £6,000.

The Jute fibre is the inner bark of an Indian plant. It is separated from the outer bark after steeping, and a fine silky filament, sometimes reaching 12 ft. in length, is obtained. This is cleaned, dried, roughly assorted, packed by hydraulic pressure into bales of about 400 lb. each, and is then ready for shipment. These bales are swung from the sides of the import vessels in the docks at Dundee into railway wagons, which are unloaded



MR. JAMES COX.

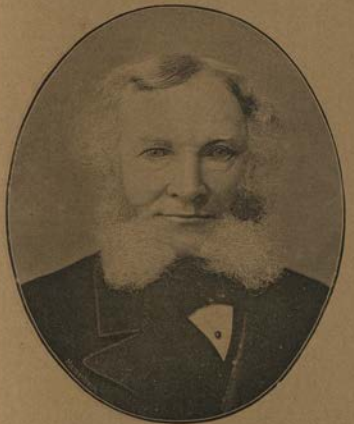


MR. WILLIAM COX.

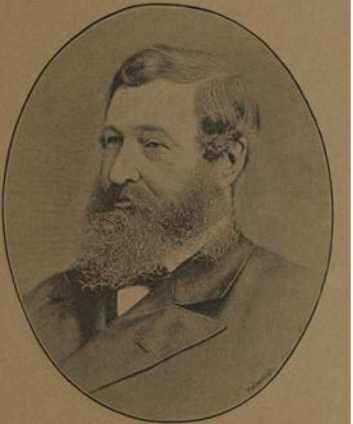
at the doors of the warehouses at the Works. From the warehouses the bales are taken to the batching-house, broken up, and the various qualities assorted. The fibre is then subjected to a mixture of oil and water to facilitate its subsequent treatment; and here it may be interpolated that the position of Dundee as the natural head-quarters of the Greenland and Newfoundland whale and seal-fishing, has hitherto formed a valuable accessory to the development of its Jute trade. The further processes of carding, drawing, and roving gradually reduce the filaments in thickness, and increase them in length, while the last process, the spinning-frame, turns out the finished yarn on bobbins. These bobbins are reeled into hanks, which are again made up into bundles, and in that state the yarn is ready for sale. But, if to be woven into cloth on the premises, the bobbins and bundles are transferred to the warping-mills and winding-machines, the product of which is then ready for weaving in the looms. Where requisite, the intermediate processes of bleaching, dyeing, and starching the yarn are effected, and sometimes this is done in the cloth.

The Calendering department has an important part to play in finishing the cloth, as well as preparing and packing it for transport to the various markets of the world into which it finds its way, except where prohibitive tariffs are imposed. A reference to the illustration will show the lofty, spacious, and well-lighted

buildings in which these operations are carried on. The spinning-mills contain over 20,000 spindles, and the weaving-sheds 1,000 power-looms, ranging from 30 in. to 120 in. wide. About 120,000 bales of Jute, of 400 lb. each, are annually used, which is one-eighth of the consumption of the town of Dundee and district, and about one-fourteenth of the total imported into Great Britain, which includes much that finds its way to the Continent. Besides large quantities of every size of yarn sold to the trade, the length of cloth annually produced is from 30,000,000 to 40,000,000 yards. Even a partial enumeration of the woven products of Jute manufactured at these Works will show how widely the fibre is made to enter into the commercial, agricultural, social, and even personal life of the world. There is the universal packing material called Hessian, sacking, bagging, tarpaulins for wagon and rick covers, shop twines, cords, ropes, harvesting and trussing twines, potato-sacks, grain-sacks, flour-sacks, hop-pocketing, biscuit and salt bags, sugar-bags, cement-bags, horse-blanketing, camp-stooling, wool-packs for the Colonies, mattress cloth, or bed ticks, furniture cloth, embroidery cloth, cloth which, laid under an ordinary carpet, gives it the soft elastic tread of the richest Turkey carpet. Mattings, hearth-rugs,



MR. THOMAS H. COX.



MR. GEORGE ADDISON COX.

stair-runners, curtains, crumb-cloths, table-covers, bed-covers, towels, tailors' padding, tan canvas for school-bags, trunk covers, and many others too numerous for detail. The Firm's yarns and cloth are highly esteemed for good quality, regularity and excellence of manufacture and finish, as well as smartness and neatness of make-up. This can be readily understood when it is known that, with the exception of the engines, boilers, and calenders, most of the machinery, implements, and appliances are made on the premises, and include the numerous inventions which have been patented by members of the Firm. Careful selection and division of the different qualities of the raw material, and minute oversight of all the processes, leave nothing wanting to secure such a result.

The sewing machinery is remarkable for the overhead hand-stitch sewing-machine, the invention of a Dundee mechanic—James Laing—which combines a firm, efficient stitch with almost electric rapidity of working.

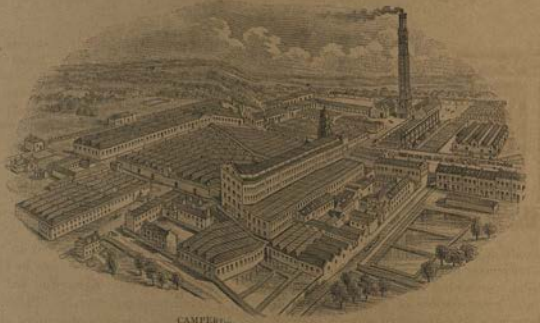
An establishment of this kind could not be maintained without the assistance of all the trades, and, accordingly, the Works are flanked by well-equipped foundries, engineers', mechanics', carpenters', joiners', plumbers', gas-fitters', tinsmiths', grinders, painters', and glaziers' shops. Shuttle, bobbin, and reed-makers abound. Large portions of the buildings were erected by the resident staff of masons. All the malleable

iron required is produced in the large smithy, which contains eighteen forges and steam-hammers. Here the thirty work-horses are shod, and fed on the produce of a conveniently-situated farm leased by the Firm.

An excellent feature is a large dining-hall, heated by steam-pipes, and fitted with a stove and other conveniences for the workers; while 500 children, who work half-time, receive free education, in a building specially erected for the purpose, from an efficient staff of male and female teachers under Government inspection.

As a final survey of the completeness of the business, it may be said that the raw Jute is collected in India by the agents of Messrs. Cox, and selected and packed in their hydraulic press-house near Calcutta — "the Camperdown Pressing Company, Limited." After being brought to this country by a fleet of the finest and largest iron sailing vessels belonging to Dundee and other British ports, in many of which the Firm are largely interested, and undergoing all the preparatory processes,—spinning, weaving, bleaching, dyeing, and finishing—the goods are made up, packed, and despatched from the Works on railway wagons by the branch line before mentioned.

It may well be thought that the projection, extension, management, maintenance, and distribution of the products of such a concern would severely tax the energies of any Firm; but the senior of the four brothers, Mr. James Cox, of Cardean and Clement Park, who died about a year ago, latterly devoted almost the whole of his time to public affairs. He was Provost or chief magistrate of Dundee for three years, was a J.P. and D.L.,



CAMPERDOWN JUTE WORKS.

and a Director of the North British Railway, and was, if not absolutely the originator, among the first to conceive the practicability of perfecting the continuity of the East Coast Railway route by bridging the Tay, and threw himself, with characteristic ardour and energy, into the accomplishment of this remarkable work.

So highly were his services appreciated, that his colleagues in the Directorate constituted him Chairman of the Tay Bridge undertaking; and it is not too much to say that it is largely due to his exertions that the present splendid and substantial erection, with its double line of rails,—the longest bridge over a tidal river in the world,—is on the verge of satisfactory completion. He had a kindly and social nature, with a vein of quaint humour, which gave great pleasure to his friends and mitigated the severity of opposition.

The remaining brothers in the Firm are Messrs. William Cox, of Snaigow and Foggyley, J.P. for Perthshire and Forfarshire; Thomas Hunter Cox, of Maulesden and Duncarse, J.P. for Forfarshire; and George Addison Cox, of Invertrossachs and Beechwood, J.P. for Perthshire and Forfarshire. These gentlemen, besides the exertion of special business qualifications, take a lively and philanthropic interest in all that concerns the well-being and advancement of the community amongst whom they dwell; and Mr. Thomas H. Cox, to signalise the Queen's Jubilee, has just presented the Council of University College, Dundee, with a munificent donation of £12,000 towards the equipment and endowment of a chair of anatomy. The details of the business are now managed and administered by sons of the original partners, whose ability, energy, and devotion are guarantees that this great business will keep pace with the age, and not only maintain, but extend, its position.

Messrs. John S. Deed & Sons, London and Mitcham.

THE old adage, "There is nothing like leather," frequently recurs to one's thoughts while inspecting the extensive works of this Firm in New Oxford Street, London, and at Mitcham, in Surrey. It is only after reflecting on the variety of animals whose skins are dressed into leather, and the number of purposes to which they are adapted, that one begins to realise the importance of leather and its many applications to the demands of civilisation. Doubtless primitive man, when, by means of roughly-fashioned flint weapons, he began to feel his superiority over the lower animals, and to take his position as lord of the creation, soon discovered a use for the skins of the animals he had killed, as well as satisfying his hunger with the flesh of such of them as were found fit for human food. Doubtless he first discovered how to preserve them from decomposition, and then invented methods of softening and otherwise preparing them for clothing and ornaments. Ancient history is replete with references to the skins of animals (both raw and tanned), and one has only to visit the British Museum to find represented on early Assyrian and Egyptian monuments the various uses to which they were applied by those great nations of antiquity. The progress made in the arts of tanning and leather-dressing appears to have been slow compared with the advance of other branches of manufacture. The modern discoveries in chemical science have effected great improvements in economy of time, labour, and material, ensuring a greater uniformity of quality than was possible in the early days of leather-dressing. Besides, the general use of machinery has completely revolutionised the older and slower methods of manufacture. Skins are now split into two or more sheets. Each half or third of a skin is put to the purpose for which it is best adapted. For instance, the surface of a hide is used for the cheaper kinds of bookbinding and fancy articles. The next slice is made into an imitation of morocco leather for open carriages, while the remaining one or two portions are dressed black and used for the cheaper kinds of men's and women's boots. The flesh, or inner side, of the sheep-skin is made into chamois leather, the uses of which are well known, not the least in importance being its latest application, viz., the manufacture of chamois underclothing for cold and variable climates.

The preparation of leather is one of the chief industries of Great Britain, and one of the oldest firms engaged in the trade is that of Messrs. John S. Deed & Sons, whose business was established as far back as 1785. The chief articles manufactured by this Firm are moroccos, sheep-skins, hides, and chamois leather; also sheep and Angora goat-skin rugs. Shabracks, used as coverings for cavalry saddles, are also made from sheep-skins with short curly wool, prepared by Messrs. Deed & Sons. Moroccos made from the choicest sorts of goat-skins are dyed by them in every conceivable shade of colour, finished either dull or bright, fine grained or levant, according to the desire of the consumer. Sheep-skins are dressed either to imitate real morocco leather or as a substitute for the more expensive kid leather, which is so much used for ladies' boots of the best quality. Hides are dressed as buff leather for army accoutrements, or for carriage harness, or shoe manufacture. Chamois

leather is dressed by a process similar to that employed in the preparation of buff hides. Sheep-skins and Angora goat-skins for rugs have to be dressed with great care to prevent the wool or hair from coming off, and at the same time to ensure a handsome appearance with perfectly fast colours. This fastness of colour is particularly necessary when sheep-skins are used for shabracks, and it is a specialty of which this Firm have always been justly proud. During some of the recent wars they turned out large quantities of undyed wool skins for the protection of soldiers in the field against the inclemency of winter weather. On one occasion Messrs. Deed & Sons produced a thousand skins daily for this purpose, and, with their present facilities, they

A Corner of the Drying Room.

A Corner of the Dyeing Shop.

could, if occasion required, do twice that number in addition to their usual large production of almost every sort of leather.

The Works at Mitcham Common are very extensive, and are situated within their own grounds, which are of more than ten acres. The supply of water and water-power is obtained from the River Wandle, which,

Finishing Room.

Eagle Mills.

rising from the chalk of the Surrey Hills, runs through Hackbridge, Mitcham, Merton, and Wimbledon, and finally falls into the Thames at Wandsworth; a stream all-sufficient to drive three powerful water-wheels at Messrs. Deed & Sons' Works, which, even without the available supplementary steam-power, is generally found ample for all ordinary purposes.

It may surprise some of our readers to learn that excellent trout fishing can be found in a river so near the metropolis; but it is nevertheless a fact, and the money value of the fishing rights attached to the Eagle Mills is not a small one.

The various processes of leather-dressing are somewhat difficult of explanation to the uninitiated, and perhaps not particularly interesting to the general public, therefore we shall content ourselves with a brief description of a few of the processes, accompanied by illustrations of the men at work. It being necessary to remove all hair or wool from the grain side or surface of the hides or skins, this is effected by the use of lime, which, causing the pelt to swell, loosens the roots of the hair, so that it can be easily removed by rubbing. The effect of lime is also to prepare the skin for the subsequent processes. Many attempts have been made to substitute other materials for the purpose, but none of them have been entirely successful.

After the lime has done its work it must be got rid of effectually, as it is destructive to the gelatine of the pelt. This is done by a process called "puring," necessitating the use of a natural animal product or a chemical substitute. This is followed by a bran drench, which thoroughly purges the skin, rendering it perfectly clean, and ready to be made into leather. This process of puring and drenching is perhaps the most important of all, and is a very critical one, especially in sultry or stormy weather.

The workman in charge has to be as careful as a gentleman's gardener is of his most delicate hothouse plants if he wishes to prevent very serious loss to his employers. The skins are now ready either for tanning in bark or sumac liquors, or for tawing by salt, alum, eggs, and flour. This latter process is only used to produce what is generally known as white or kid leather. Hides for buff, or sheep-skins for chamois leather, do not require "puring" or drenching, as the loshing or leathering by means of cod oil requires the presence of a certain amount of lime in order to produce the necessary heating or fermentation which makes this kind of

leather. The oil is hammered into the pelts by gigantic wooden hammers in machines called "stocks," worked by water-power.

After a sufficient number of "stockings," "airings," and "heatings-off," the hides or skins are dipped in warm water before being subjected to hydraulic pressure to remove all superfluous oxidized oil and fat, forming a product called "sod oil." This oil is much valued by curriers for its peculiar softening qualities, and is used in dressing tanned leather for boots. Morocco for upholstery, carriage, and bookbinding purposes, have to be most carefully selected in the tanned state, and appropriated to the various colours for which their natural qualities seem to adapt them. They are then dyed in trays, as shown in one of our illustrations, then shaved or levelled, and struck out to make them flat, after which they are finished, either "bright grained" with a polish produced by the friction of boxwood or agate rollers on the surface, or "dull grained," by simply raising the natural grain or corrugations of the skin, employing for this purpose a flat board covered with a layer of cork. The grounding and frizing processes, also shown in the accompanying illustrations, are principally for tawed sheep and loshed chamois leather; the object of the work being to soften and extend the skins, so as to make them fine and smooth.

Space will not permit a fuller description of how the work is done, but the care exercised by Messrs. John S. Deed & Sons in the selection and manufacture of their goods has been fully recognised at all the principal International Exhibitions since 1851, and rewarded by their gradually-increasing orders from the best buyers in all parts of the world.

Traders

Messrs. Lewis & Co., Liverpool, Manchester, Birmingham, and Sheffield.

ANY ONE who is at all acquainted with the North of England will bear witness that the name of "Lewis's" has earned the respect and confidence of the toiling millions, because of the originality and honesty with which they have catered for their convenience and comfort for nearly a generation past. It is no exaggeration to say that the Firm's combined businesses in Liverpool, Manchester, Birmingham, and Sheffield constitute them the greatest retail merchants in the British Empire. Lewis's have been the creators of a system of business, which as a model of excellence and perfect organisation will serve to be studied and copied by many large retailers for years to come. Their wonderful career, marking, as it does, a striking and unparalleled revolution in the retail trade of the latter half of the nineteenth century, is as interesting as it is instructive.

The foundation of the Firm's career was "well and truly laid," in the year 1856, upon sound business principles and a policy of steady industry. Continued prosperity has not been gained by any secret or royal road, but simply by following homely maxims and rules, which every one can learn, but which so few care to take to heart in attempting to form the structure of their daily lives. Like the growth of a well-nurtured plant, the development of the concern was early, lusty, and rapid. As trade progressed, department was added to department until an extension of the various premises became a necessity, and last Christmas the business exceeded by a hundred times its original dimensions. It is a curious coincidence that the Firm was founded by the late Mr. David Lewis in the same year in which the famous *Great Eastern* was launched, which vessel was chartered, about twelve months ago, to be converted into a floating palace of amusement for the people of Liverpool, through the enterprise of Mr. Louis S. Cohen, now senior partner of the Firm, a gentleman who, indeed, has been actively identified with Lewis's history during the last twenty-five years.

The premises, originally opened in Ranelagh Street, Liverpool, were extended, from time to time, over a space previously occupied by many shops and dwellings, until at last they attained a height of nine storeys, with frontages in three streets. This space does not include the stabling accommodation, or the various factories which are carried on separately from the retail premises—the land in the vicinity of which is too valuable to be sacrificed for the convenience of the merely mechanical branches. At this stage, it may be well to remark, that the disastrous fire which occurred at this colossal building last Christmas (1886), destroyed a great portion of the block, but Her Majesty's Jubilee year is to be celebrated by the restoration of the pile upon a scale of still greater magnitude. From the architect's plan we are enabled to give an exterior view of the new building, which will be monumental of the Firm's energy, and the importance of their trade in the famous seaport of the North of England.

For the first ten years of the Firm's progress, the business carried on was exclusively for the sale of boys' clothing. Everything was manufactured on the premises, and such was the satisfaction given to customers

DAVID LEWIS, FOUNDER OF "LEWIS'S."

that, as the boys became men, they resolved to be still clothed and entirely fitted out at Lewis's. In the next ten years, therefore, the Firm confined their attention to the outfitting of men and boys, when it was found that yet another change was necessary. The men, obeying that most pleasant law of nature by which the ladies are taught how best to exercise their rights, became Benedicts, and their wives insisted that they, too, should look to Lewis's as the suppliers of their wants in the direction of dress and household necessaries. The members of the Firm were not slow to comply with this flattering demand, and now the Liverpool people have got accustomed to visit Lewis's establishments for all their requirements, no matter how extensive or how trifling they may be. Anything original, every new idea or invention applicable to the enlargement of their business is seized upon by the Firm. They were certainly the first in the North of England — if not in England itself—to utilise the electric light. They have large engines, and adopt the best systems for the application of this illuminating power; and throughout their various establishments, have invested at least £20,000 in it. Notwithstanding this, Lewis's gas bills are something to excite marvel. The sum expended on gas in Liverpool is £1,800 a year; in Manchester, £2,000; and in Birmingham, £900; making a total of £4,700. The number of people employed by the Firm is, in the aggregate, upwards of 10,000, and of these at least 3,000 are in receipt of weekly salaries.

LEWIS'S, LIVERPOOL, 1886.

The Liverpool business continued to grow to such dimensions that it again became an urgent necessity to discover fresh streets and buildings new. With their accustomed decision and promptitude, Lewis's entered into treaty with the Corporation of Liverpool for the acquisition in Basnet Street of a building now well-known as the Bon Marché. As soon as this was secured it was formed into a high-class drapery establishment, but the march of trade soon compelled the Firm to enlarge it to twice its previous size. The Bon Marché now extends its imposing presence into Church Street, and has so made progress in favour of the fair ladies of Liverpool, that the space it occupies has become almost inadequate. The value of the land and premises exceeds £100,000; and the sum total of the business done in Lewis's two Liverpool establishments approaches the immense figure of £1,000,000 sterling per annum.

"BON MARCHÉ," LIVERPOOL.

The largest amount of business done by the Firm was, we believe, in the course of 1886; and in the same year, early on the morning of the day before Christmas —the busiest of all busy days at Lewis's —occurred the tremendous and disastrous fire which, any ordinary Firm, would have been a crushing catastrophe. To Lewis's it has been but an incentive to fresh efforts in the field of enterprise. Only two hours before the conflagration broke out, the premises had been inspected in the usual way, and left apparently safe, yet in a brief time the greater portion of the magnificent pile was razed to the ground. The worth of the stock and buildings actually destroyed was £100,000, a sum independent of the loss arising out of damage by water to the goods saved. Under such a perfect system has the Firm's business always been conducted, that on the morning of the *fire, Lewis's* were able to tell the insurance companies the extent of their stock, its value, and the probable amount of damage done. So satisfied were the companies, that they at once appointed assessors acceptable to the Firm, and stock - taking was begun without delay, so as to admit of a speedy resumption of business. The assessors, conjunction with Lewis's assistants, worked day and night, with the result that whereas it had seemed at first impossible to resume for if — as many business for some months, again, the doubted—ever was re-opened establishment credibly within the short space of three days, and trade carried on to a greater extent than before, in the very midst of the ruins. Since—it might almost be said in consequence of—the fire, the business has steadily continued to grow, and judging by this fact, even the new building, when finished, will be tested to its utmost capacity. After the premises were

LEWIS'S, MANCHESTER.

gutted, the large clock-tower which, rising to a height of 150 ft., had been their special feature, was left standing, but in such a condition as to be a source of danger to the public and the adjacent property, especially the premises of the Central Railway Station; and after serious thought and discussion, it was decided, in the interests of safety, to blow it up. In the presence of Mr. Cohen, the police, salvage, and railway officials, and an immense crowd of spectators, a charge of dynamite was placed in an aperture in the corner pillar by an experienced official of the Mersey Docks and Harbour Board, named Rylatt. After a minute or two of anxious suspense, a loud report was heard, and instantly the central portion of the tower was seen to totter and fall towards the ruins caused by the fire, whilst the upper part, including the clock and vane, weighing, with their massive iron supports, many tons, fell straight as an arrow into the street below, and within a few yards of the tower's base. The pent-up excitement of the thousands who had witnessed the operations found vent in ringing cheers, and Rylatt was afterwards handsomely rewarded by Mr. Cohen for having done his work so well. As a coincidence with regard to this fire, it may be stated that, in 1865, the premises of Messrs. David Cohen & Co., of Maitland, New South Wales, —with which house the late father of Mr. Cohen of Lewis's was connected,— were burned to the ground, the Firm losing about £165,000. Of this, £65,000 were covered by insurance, leaving an actual loss of £100,000. So satisfied were the insurance companies with the conduct of the Firm, that they paid them in full, and gave them all the salvage. D. Cohen & Co., of Sydney, whose business is about the largest in that thriving city of the southern hemisphere, may be said to be the "Lewis's" of Australia.

LEWIS'S, BIRMINGHAM.

A glance may now be taken at the briefer history of the Manchester premises. These are situated in Market Street, and were opened in 1880. Architecturally, they vie with the Liverpool buildings, passed by any structure and are certainly unsurdevoted to retail trade in England. The building is designed in the style of the French Renaissance, with a frontage of one hundred and twenty feet, and extending back about seventy feet, while the height from the sub-basement to the summit of a tower, forming a conspicuous feature of the structure, is close upon three hundred feet. The Manchester tradesmen soon began to fear that Lewis's energetic rivalry would tell adversely against them, and some pursued a system of petty persecution and annoyance towards the new Firm, with a view to injure them, but they only helped to raise them in the estimation of the public. In the case of a local newspaper editor, who made some most uncalled-for and unjust comments upon Lewis's methods of doing business, the Firm felt compelled to seek redress in a court of justice. The editor was defended by Sir Charles Russell, Q.C., M.P., the leading counsel for Lewis's being Sir John Holker, Q.C., M.P. The Firm, having fully vindicated their character, did not proceed to harsh measures with their traducer, who luckily escaped with a fine. This action, by the way, cost Lewis's £3,000. At another time, the Corporation of Manchester, many of whose members were local tradesmen prosecuted the Firm for causing an obstruction in the street. The obstruction consisted of the crowds of people who were induced to congregate about the shop by the display of novelties in the windows. Lewis's were compelled to promise to remove the cause of complaint —in other words, make their premises less attractive to the public in future, so that less enterprising tradesmen might get customers.

In 1883, the ever-restless Lewis's opened a large establishment in Sheffield, and such has been the rush

of trade that these premises are also shortly to be extended. Again, in 1885, the people of Birmingham were pleasantly surprised to see one of Lewis's buildings being raised in their town. The design of these premises, both externally and internally, is of a very stately character. The central part of the building forms an immense dome, around which the various floors are built in the form of galleries. Thus, from any given point, a bird's-eye view of the interior can be obtained—an arrangement which assists to the well-carrying out of the business, on account of the ease with which even the most trifling detail can be supervised. It is noteworthy that the buildings and stock in Liverpool are valued at nearly £400,000, in Manchester at upwards of £350,000, and in Birmingham at £150,000. Nothing seems too vast for Lewis's to undertake, and they bring such keen discrimination and common sense to bear upon their affairs, that success seems to follow as a matter of course. They attribute their prosperity to the fact that they have always been prepared to work with the amount of energy necessary for conducting an immense miscellaneous retail business, contenting themselves with the smallest possible profits upon each separate article sold. They foresaw plainly, moreover, that the operation of this principle would, in the long run, free supplies from the trammels of the middleman, by making the retailer also become the manufacturer, with the ultimate effect that the advantage would be with the public, who could thenceforward purchase direct at only a small margin above cost. How this reform has first been gradually brought about, and accepted as an inevitable necessity, is now demonstrated in various departments of trade; but Lewis's may take credit to themselves for having been among the prime movers in this direction. Lewis's, so to speak, enter into partnership with the public. They provide the capital, skill, and business qualities, and only ask for a moderate percentage upon their outlay, the rest of the profits going to their co-partners—the public. The man who enters the market with unlimited means can dictate terms, whereas the one who has but a small capital, or who can only offer payment by monthly or quarterly bills, must take whatever terms he can get.

LOUIS S. COHEN.

Lewis's have had the honour of being patronised by the Queen, the Princess of Wales, Princess Louise, the Duchess of Connaught, and many of the nobility of Europe. They have also supplied goods to the orders of the Duke of Wellington, the Earl of Derby, and other leading members of the British aristocracy; but they pride themselves upon the fact that their business is essentially with the masses. Yet when it is considered that these orders have been forwarded from London to a provincial town, then the honour is all the greater, and may be regarded as a recognition of the Firm's enterprise and fame. Another instance of Lewis's remarkable originality, was the bold scheme they inaugurated in reference to the *Great Eastern*, with the result that the vessel was brought into the Mersey from Milford Haven, where she had lain rusting for more than twelve years. They formed a company to convert the monster vessel into a bazaar and pleasure resort, and during the time that the Liverpool International Exhibition was being held, the *Great Eastern* was daily thronged by sightseers. After a brilliant season of five months, the spirited charterers were enabled to pay the owners, who had a share of the profits, a sum exceeding £10,000, besides clearing an equally handsome sum for themselves. While at Liverpool, the ship was visited by upwards of 560,000 persons who were conveyed by a fleet of river steamers provided by Lewis's. Altogether, 1,100,000 trips to and fro were made, and happily not a single accident occurred to mar the enjoyment of the holiday makers. Although the Firm could easily, and no doubt profitably, have repeated their speculation in other important seaports, they preferred not to do so, being unwilling to neglect their own legitimate business. It is said that Lewis's intend, sooner or later, to establish a branch in every large town in the kingdom.

The late Mr. David Lewis, the founder of the Firm, who died at the age of sixty-three, left no family, and his relatives being all well provided for, he has, we believe, bequeathed the bulk of his fortune for the benefit of the working classes, but in what way has not yet transpired. During his lifetime his charities were dispensed with a free hand, and unrestricted by any sectarian prejudices. When the Jews were being persecuted in Russia, and the Rothschilds opened subscriptions in their behalf, he gave a thousand pounds to the fund. A Jewish synagogue, said to be the finest in England, and from which that in the West-End of London took its style of architecture, was first promoted by him for Liverpool. To it he contributed several thousand pounds, in addition to a beautiful marble pulpit at a cost of nearly another thousand pounds. The result of his labours in this direction was a building costing nearly £20,000. A recent act of generosity on his part was a gift of free breakfasts to 20,000 of the unemployed in Liverpool, and this splendid munificence was continued for a month.

The Liverpool business is now carried on by Mr. Louis S. Cohen, whose portrait appears in connexion with this historical sketch. Mr. Cohen is a son of the late Mr. Samuel Cohen, M.P. for the town of Morpeth, New South Wales, which electorate is now represented by Sir Robert Wisdom, K.C.M.G., late Attorney-General for that colony, who has come to England as Colonial Delegates. The other branches are superintended severally by Mr. Elliot Levy, son of the late Mr. L. W. Levy, Member of the Legislative Council of Sydney, New South Wales; Mr. Beresford S. Cohen, and Mr. Herbert D. Cohen, all of whom are nephews of the late Mr. David Lewis. Before concluding a brief record of this phenomenal success of the Firm, it is but fair to say that Lewis's have been "the friends of the people" in an educational sense. They were the first to introduce the publication of complete penny editions of popular English authors. The poorest man in the community can have no excuse for being illiterate when such opportunities for information as Lewis's have afforded are attainable. The most important of their recent editions have been a Shakespeare for the people, and a volume of penny readings, which contains choice selections from modern writers. Of this close on a million copies were sold in twelve months, and Lewis's received letters of commendation from many prominent personages. Lewis's give £100 a year in cash prizes to school-children for good handwriting in neatly-kept exercise-books, and the quarterly competitions have become immensely popular. An interesting publication issued by the Firm is a "Penny Directory of Liverpool in 1790," containing a list of merchants, tradesmen, and principal residents at that time, and a variety of other matter, together with a map of old Liverpool. In those days the journey from London occupied twenty-seven hours, and the fare was sixty-nine shillings outside the coach. In 1790 the population of Liverpool was 56,000, as against 560,000 at the present day, an increase of 1,000 per cent.

LEWIS'S, LIVERPOOL, 1887.

Lewis's claim that their business has increased in the last quarter of a century 1,000 per cent., whereas it has taken Liverpool ninety years to accomplish the same ratio. They might reasonably boast of having reached such a distinguished position in commerce in so short a period, but boasting is not to their mind. It only remains to emphasise that the unique reputation they enjoy is the reward of hard work and upright dealing; and if England may yet be truly termed "a nation of shopkeepers," her sons have no cause to be ashamed of the title while Firms like Lewis's set other nations the example of enterprise and probity.

The Prudential Assurance Company, London.

INSURANCE was unknown to the Ancients. It had its origin in the exigencies of Commerce, and was first applied to mercantile adventures. The fear of pecuniary ruin by the loss of ship or cargo checked the spirit of enterprise. Few were so wealthy as to be able to bear alone so great a loss; but by dividing the risk amongst many, it was seen that the inconvenience to each of the proportion of loss which he assumed might become trivial. Thus originated the practice of insurance, which has for its purpose to break the force of the blow of calamity by increasing the power of resistance. Though known and practised amongst the commercial communities of Southern Europe at a much earlier period, it was a comparative novelty in England in the time of Elizabeth.

During the last century, however, it has received an immense development, so that now every prudent person who has property at risk takes care to seek shelter under a policy of insurance. It does not appear that the principles of insurance were applied in any definite form to transactions depending on human life until about the sixteenth century. At that time, and for long afterwards, in England, the private underwriters who carried on the business of insurance sometimes undertook risks upon lives for short periods to cover contingencies of a temporary character. The premiums were very high, but this was in part necessary, for two reasons:—first, the insurers had no sufficient data upon which to estimate the risk they incurred; and secondly, transactions were probably not numerous enough to secure anything like a regular average in the occurrence of claims.

About the end of the seventeenth century several annuity schemes were formed, notably that of the Mercers' Company of London, for the benefit of the widows and orphans of subscribers. These schemes, however, and numerous others of similar character promoted in the succeeding century, failed for lack of correct data and sufficient knowledge of the principles which should have guided their operations. But the idea of uniting the contributions of a number of persons in order to make a provision available on the death of each had taken some hold on the public mind. Its first practical embodiment in the direction of life assurance, but still far short of that system as it is now understood, was the foundation of an Assurance Society by Royal Charter in 1706. The scheme was simply to raise a fixed contribution from each member, and from the proceeds to distribute a certain sum each year among the representatives of those who died during the year.

It was not until 1807 that the first assurance society under a fresh charter began the practice of rating new members "according to the age and other circumstances." Up to the year 1844 over one hundred and forty companies and societies had been established, on a more or less solid footing, for the purpose of transacting life business, either alone or in connexion with other forms of insurance, and of these offices upwards of one hundred remained in existence.

OFFICES OF THE PRUDENTIAL ASSURANCE COMPANY, HOLBORN BARS.

LIFE ASSURANCE.

During the reign of Her Majesty Queen Victoria no life assurance company has achieved a greater success than the Prudential, and no industrial life assurance company in Europe can show such a satisfactory balance-sheet as the subject of this article. If we consider the system of life insurance from a strictly commercial point of view, or if we judge it on its merits as a boon to the thrifty section of the population of this country, we cannot get away from the fact that the founders of the Prudential Life Assurance Company have accomplished a great work, the magnitude of which can only be realised by persons who imitate our example, and view the premises in Holborn, London, where the enormous business of this Company is transacted. The building, which covers nearly an acre of land, was designed by Mr. Alfred Waterhouse, R.A., who is always consulted by the Company whenever alterations or extensions are required. The noble frontage in Holborn at once impresses the stranger, and prepares him for still greater surprises when he enters the stately edifice, which owes its existence to the indefatigable labours of the founders of the Company and the thrift of the industrial classes of Great Britain.

In these days of sanitary reform and scientific progress we are prepared for ingenious contrivances for the conservation of manual labour and the strict observance of the laws of hygiene; but we must confess that, on the occasion of our visit of inspection to the premises of the Prudential, we were amazed to find that the enterprising managers of this Company had availed themselves of a number of mechanical and electrical appliances generally met with only in connexion with Government institutions and works of an extensive character. At our special request we were first conducted to the engine-room—one of the finest we have ever entered. For appearance, ventilation, and capacity it would be difficult to imagine its superior. Two splendid engines by Marshall & Co., of Gainsborough, each capable of being worked up to 100-horse power, occupied the central position. The fly-wheels of these engines measure 13 ft., and the leather bands are 2 ft. in width. They are both furnished with Marshall's new governor, and, according to the engineer in charge, the admission of steam to the cylinders is regulated to such a nicety that no trouble is ever caused through variations of speed. One engine was driving, almost noiselessly, one of Messrs. R. E. Crompton & Co.'s 500-light dynamo-electric-machines. Observing the steadiness of the electric light, we inquired if secondary batteries were employed, and we were informed by our courteous guide that the four dynamos—two "Cromptons" and two "Siemens"—were used for charging the secondary batteries. We were then conducted to the battery-rooms, which, in cleanliness, ventilation, and the arrangement of the cells, far exceeded the most ambitious attempts of the engineers of the old telegraph companies or the present battery departments of the Postal Telegraph Service. Arranged upon shelves were rows of the Electrical Power Storage Company's latest improvements in secondary cells, which have given the utmost satisfaction to the engineers of the Prudential. The outsides of the glass vessels were free from dirt, so that the condition of the plates in each cell could be seen by the officer in charge of the electric light department. Each secondary battery is made up of 132 cells. There are four batteries, making a total of 528 cells. The secondary batteries are put in circuit with the dynamos by means of Drake & Gorham's ring-contact switches, and the number of units (ampères of current) is read off from the Electrical Power Storage Company's special form of ampère meter. The same Company is responsible for this splendid installation of electric lighting. The switches for turning out the lights are fitted all over the building, and they perform their functions admirably. In every part of the vast premises we noticed the familiar glow-lamp; and the only gas-jet employed is used for the sealing-up of parcels of stationery! The executive of the Prudential Assurance Company fully appreciate the advantages of electric lighting. Our guide pointed out that not only would the health of the staff be benefited, but, in time, the Company would save large sums through the absence of noxious gases and the freedom from sooty deposits, which will enable the piles of records and letters to be kept for years perfectly clean and uninjured by the products of combustion.

Before leaving the machinery department we glanced at the three large boilers, which are worked up to 80 lb. pressure, and are used for heating purposes as well as for driving the engines. The engines, too, are used for pumping air for the pneumatic despatch department, which we shall describe later on. In the basement, which extends beyond the end of Brook Street, is situated the engineers' workshop and the office of the clerk of the works, a gentleman who is regularly employed by the Company to prepare plans and carry out alterations and repairs. There is also a messengers' mess, a gymnasium for the use of the male staff, a stationery department employing a number of men, and a carpenters' shop.

Our next visit was to the Prudential Company's Pneumatic Exchange, by means of which the chief officials of thirty-four different departments are in constant communication.

For a number of years past the telegraph offices in London have communicated with the Central

Telegraph Station, St. Martin's-le-Grand, by pneumatic tubes, in which the air is exhausted in front of the carrier and condensed behind it. These tubes are arranged in circuits, so that the current of air is continuous, and conveys messages in each direction at the same time. The messages are placed in little cylindrical felt bags, accurately fitting the tube and urged forward by compressed air. The tubes are connected, one with a vacuum chamber and the other with a compressed air chamber, air being compressed in one and exhausted in the other by an air-pump worked by a steam-engine.

The Prudential Company's pneumatic system was suggested by the late eminent electrician, Mr. Cromwell Varley; and Mr. Eaton, of the engineer-in-chief's department of the Postal Telegraph, superintended the fixing of the tubes and the adjustment of the apparatus. One man is constantly employed in receiving carriers containing messages and transmitting them to their destination. An electric bell rings, and an indicator-needle points to the number of the department from whence the message is coming. The attendant receives the carrier and reads the number upon the cylinder,—say it is 24, that signifies that the message is to be sent on to No. 24 department. The carrier is placed in another tube, an electric signal is sent, and off shoots the carrier to "24," where it is received by a clerk and handed to the official for whom it is intended. In the short space of time during which we watched the operations, many messages were received and transmitted. We almost fancied that we were in the Central Telegraph Office, looking at the Government system of pneumatic despatch, instead of the transmission of the messages of a single insurance company. The saving of labour effected by the pneumatic tubes is very great, and we can imagine how thankful the junior clerks must feel for this leg-saving system of intercommunication.

After an interesting examination of the machinery, we were conducted through the various sections of the building. One long room is fitted up exactly like the sorting department of a district post-office. At eight o'clock every morning a set of clerks arrive and receive from the Post-office official all letters addressed to the Company. By a special arrangement with the authorities, there is only one delivery a day. The letters are first sorted into geographical divisions, thus:—A letter from the London district will be thrown into the division marked L, while one from Brighton will be added to the letters from the southern counties. When all the letters are sorted—numbering between 4,000 and 5,000 daily—the nine o'clock staff of "opening clerks" take possession of this department and every letter is opened, two messengers collecting the waste envelopes. Remittances from agents are enclosed in separate envelopes, which are not opened by these clerks. When all the letters have been opened, they are placed in drawers geographically divided, and then clerks from the various departments enter the sorting-office, empty the drawers, and carry away the letters. The magnitude of the correspondence will be understood by the fact, the Post-office people deliver the Prudential letters by a special cart! The amount spent in postage-stamps alone for, letters forwarded from the chief office exceeds £300 per week, and an equal sum is expended on agents' letters to head-quarters. Altogether, the Postmaster-General can reckon upon £600 per week from the Prudential Company. There are few companies of any kind yielding such an important sum to the revenue as £30,000 a year for postage-stamps.

When the letters are answered, the replies are dictated to clerks or written on the turned-up corners of the paper, and they are despatched to the ladies' department, where they are duly copied by the fair scribes and sorted "geographically," prior to their despatch to the forwarding department. There are at present 190 female clerks, under the direction of one lady-superintendent and a number of supervisors. Only the daughters of professional men are engaged for this department by the Prudential, and the way in which these young ladies are treated reflects the highest credit upon the directors and managers of the Company. The ladies begin duty at ten a.m. and leave at five p.m. When once they enter the building they are not allowed to go out until they are off duty. This is a wise arrangement, for some trouble might arise if a large number of young attractive girls were allowed to leave the premises at luncheon time in the heart of London. The admirable arrangements made for the comfort of the ladies leave nothing to be desired. There is a spacious dining-room, where a substantial meal can be obtained for a nominal sum. After luncheon, the studiously inclined can walk into the library, and there find excellent food for the mind. If the weather will permit, the ladies are allowed to walk upon the roof of the vast building, and there enjoy the fresh air. The roof, which is of iron, is arranged in terrace fashion, and well supplied with comfortable garden seats. These fortunate female clerks are to be envied by the ladies of the Post-office, and other institutions where female labour is utilised. Six hours' work per diem in a splendid building, where the laws of hygiene are obeyed, and where comfort is studied in all its detail! Well may the Prudential be inundated with applications from young ladies who are anxious to earn their own living. We were informed that in consequence of the demand for vacancies, it is no unusual

thing for a girl to have to wait three years for a clerkship in the Prudential. In addition to the writing of letters, the ladies have to examine proposals, prepare policies, and fill up statistical cards.

The letter-room contains about two hundred letter-books. These books, however, only contain copies of the current year's correspondence. In the basement we noticed tons' weight of letters and papers. Every document, every scrap of paper is jealously guarded, for, as we were informed, one never knows when an apparently worthless letter or statement may be suddenly transformed into an important piece of evidence. There is a large section of the building devoted to the storage of statistical cards, which are geographically arranged, and any single card can be found without a moment's delay. There are 9,000 agents attached to the Prudential, and each agent has a certain amount of space allotted to him for the storage of his statistical cards.

The Audit department is admirably managed. The clerks here do not receive any cash, but they have to be responsible for the payment of premiums due every week on over 7,000,000 policies.

The other departments include:—

The "Ordinary" department, where the business of an Ordinary, as distinguished from an Industrial Assurance Office, is carried on.

A Paying-in department, where upwards of 9,000 remittances are received every week. Through this department more than two millions sterling passes during the year.

A Forwarding department, which is divided geographically, representing different parts of the country. All the correspondence has to pass through this department, with the exception of letters containing cash remittances.

A Policy department, from which the number of policies issued exceeds 30,000 a week. Each proposal is four times examined, and initialled by four different persons.

The Paying-out department, in which 400 claims are paid daily. The amount paid in claims by this office has reached the enormous sum of eight millions sterling.

There are various other departments, employing altogether 600 male clerks, and with the female staff making a total of 790 clerks.

We have noticed the ladies, and what has been done for their health and comfort. We will now briefly review the position of the male clerks employed by the Prudential Assurance Company. There are over 2,000 volumes in the library, and any clerk may borrow books to read at home as well as on the premises. There is a raised platform at one end of this room, and a piano. Vocal and instrumental entertainments are frequently given by the employés of the Prudential, who boast of possessing their own band, so that they are quite independent of professional assistance from outside. In addition to the musical society, there is a Rowing Club and a Cricket Club, the athletes being well provided for.

The Board-room is a handsome apartment, and on the walls are oil-paintings of some of the men who have laboured hard and long to make the Prudential Assurance Company one of the noblest and best institutions in the land, including the late chairman, the Rev. James Gillman, B.C.L.; Henry Harben, Esq., late secretary, now deputy-chairman; and Edgar Horne, Esq., the present chairman of the Board of Directors.

Although the entire building may be said to be fire-proof, there is a Prudential fire-brigade, and the most elaborate arrangements for the immediate turning on and direction of water are to be found on each floor. The walls are lined with enamelled fire-bricks, which only require wiping with a damp cloth whenever dust accumulates upon them. The safes are *rooms*, each capable of containing scores of the ordinary safes one sees in moderate-sized places of business. All documents are in duplicate, so that if a fire were to destroy one set, the duplicates would, in all probability, be saved. It will be easily understood that the work of calculation could never be performed with the necessary accuracy without the aid of tables of logarithms or the use of the calculating slide-rule. Formerly, insurance companies worked out their rates of interest and abstruse calculations by means of logarithms, but since the introduction of the cylindrical slide-rule by Mr. George Fuller, C.E., and the wonderful calculating-machine of M. Thomas de Colmar, logarithmic tables are conspicuous by their absence.

The instruments invented by Thomas de Colmar, used by the Prudential, were formerly made in France, and they were liable to get out of order just at the moment that they were urgently wanted. In order to stimulate English mathematical instrument-makers, the directors of the Prudential Assurance Company offered a premium of £300 to any firm who would perfect the instrument; and they also offered to pay £40 for each machine instead of £20, the amount charged by the French manufacturers. The eminent firm of mathematical

instrument-makers—Messrs. Elliott Brothers—took up the challenge, and they ultimately produced a modification of Thomas de Colmar's calculating-machine, which won the premium and satisfied the officers of the Prudential. We saw this marvellous piece of mechanism at work. Sums which would entail an immense amount of labour, and cover a sheet of foolscap paper in working out, were literally ground out of the calculating-machine in a few seconds. Forty of these instruments are in daily use at the offices of the Prudential, and *two* clerks, with separate machines, are told off to make *one* calculation. This is an excellent check, for it is highly improbable that two men will make the same error. If a mistake is made by one of the clerks, it is either in the careless reading of the figures or in the setting of the instrument. If the indicators are placed before the proper figures it is impossible for a mistake to occur.

Space will not permit us to dwell longer upon the magnificent premises of the Prudential Assurance Company. The exterior is imposing; the interior, particularly the entrance-hall, is overwhelming to the stranger who, in all probability, expects to find a large and busy office, but not a palatial structure, fitted up with everything that science and art can suggest both for the rapid despatch of business and the welfare of the army of employés. The private offices are very handsome, and the officials within them are as courteous as they are clever in the administration of their respective departments.

The Prudential is the largest life assurance institution in the world. From the latest reports, we gather that the annual premium income of the Industrial Branch exceeds £3,000,000, and this sum is collected on more than 7,000,000 policies by the agents of the Company.

The following amounts have been paid during the last five years:—1881, £639,753; 1882, £773,813; 1883, £912,333; 1884, £1,003,273; 1885, £1,069,878. During the same period claims have been paid on 17,911 deaths from accident, and the following list shows the number of deaths and amounts paid in connexion with some of the great disasters which have taken place:—1878: Blantyre Colliery explosion, £248; Excursion steamer, *Princess Alice*, collision on the Thames, £522; Colliery explosions, Abercarne, Haydock, Wigan, and Hanley, £1,302. 1880: Colliery explosions, Leycett, Risca, Seaham, and Pen-y-Graig, £1,541; Loss of H.M.S. *Atlanta*, £395. 1881: Loss of H.M.S. *Dotterel*, £226; Gale, October 14, loss of fishing fleet, £2,062. 1882: Trimdon Grange Colliery explosion, £396; Gale off East Coast, October 24, loss of fishing fleet, £449; Egyptian War, £334; Fall of factory chimney, Bradford, £237; Loss of ships, *Cosmo*, *Virago*, *Livadia*, *North Eastern*, *Douro*, and *City of Brussels*, £876. 1883: Loss at sea, gale of the 6th and 7th March, £1,074; Catastrophe at Victoria Hall, Sunderland, £246; Clyde disaster, *Daphne*, £257; Colliery explosions, Craiks, Fair Lady, and Moorfield Pits, £278; Loss at sea, gale of December 12, £857. 1884: Loss at sea, *Dione*, *State of Florida*, *Meningen*, and H.M.S. *Wasp*, £225; Fishing smacks, *Polar Star*, *Auk*, *West Ridge*, and *Pochard*, £444. 1885: Loss of Royal Mail steamer *Humber*, £242; Colliery explosions, Usworth, £149; and Clifton Hall, £627; Soudan Expedition, £879; Colliery explosion, Mardy, £432. 1886: Belfast riots, £67; Colliery explosion, Bedford Leigh, £152. These amounts represent 907 claims made by the friends of persons who had paid sums ranging from one penny to one shilling per week.

The Prudential Company pays all claims upon policies in benefit immediately upon satisfactory proof of death and title being furnished to the Board of Directors. In the case of a colliery accident, or any calamity affecting a poor industrial population, the agent in whose district it occurs has a standing order to investigate and pay all claims immediately without reference to the Head Office. Not so long ago, an accident occurred on one of the Southern Railways, and the engine-driver and fireman of the train were killed. Both men were insured in the Prudential. They met their deaths on a Saturday, and the claims were paid to their legal representatives on the following Monday morning.

Such is a brief account of this remarkable Company, which is one of the great institutions of the Victorian era. The Prudential Life Assurance Company was never in a more flourishing condition than it is at present; and, since its aims are decidedly philanthropic, we heartily echo the sentiments of about one-sixth of the population of Great Britain, and wish that noble institution a still greater development and a long run of uninterrupted prosperity.

J. N. Richardson, Sons, & Owden, Limited, Belfast.

AMONG the many commercial histories which we briefly chronicle in this ALBUM, there are few more interesting than that of the progress and development of the linen trade in Ulster; and, in order to illustrate this branch of manufacture, we have selected the Firm of J. N. Richardson, Sons, & Owden, Limited, as being one of the oldest, and probably the most distinguished, of the many successful firms in the Sister Isle.

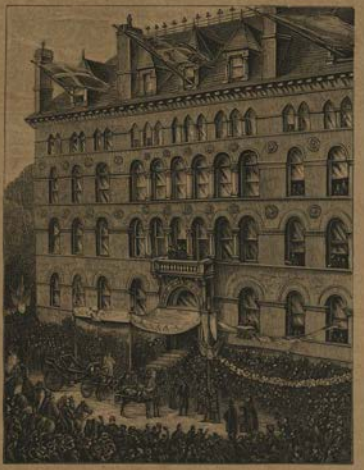
The introduction of the linen industry into Ireland was due to the Huguenots, many of whom, fleeing from France, settled in Ulster, and, as a means of livelihood, commenced to practise their native arts in connexion with the manipulation of flax. The inhabitants of the north-east of Ireland are a mixed race, combining some of the best qualities of the English, the Scotch, and the native Irish; and the example of the Huguenots was not lost upon them. Gradually a knowledge of the art of spinning and weaving spread from the Huguenot centres, until, at the beginning of this century, a large proportion of the cottage homes which stud the country contained one or more looms, the yield from which materially helped the otherwise meagre income of the inhabitants.

It is worthy of note that the various classes of linen goods were produced in distinct localities. The linen of South Down, for instance, was very different from the lighter texture produced in Ballymena; the damask trade was confined to the district surrounding Lurgan; and the coarse brown linens were known, from the locality where they were made, as Armaghs.

The invention of flax-spinning machinery, and the commencement of the use of steam as a motive power, may be said to be coincident in point of time; and thus some of the earliest spinning-mills erected in the beginning of the century were driven by steam-power. It is true, many of the very earliest mills (such as that at Bessbrook, now a gigantic concern) were erected where water-power was abundant; but the greater proportion of spindles was put in motion by steam, and the mills containing them were erected in and around Belfast.

Besides spinning and weaving, a very important branch of industry connected with linen is that of bleaching. Linen, as it comes from the loom, is not considered in a suitable state for domestic use; it has, therefore, to undergo a whitening process. The largest bleach works in the country are those at Glenmore, one mile from Lisburn and seven from Belfast, the property of the Firm under notice. Even so late as 1820 the Glenmore Works were comparatively small, but since that time they have gradually been extended year by year, in proportion as the general trade of the country has increased. As the traveller passes Lisburn by rail at the present day, he is struck by the appearance of the undulating grassy country, spread with long webs of linen arranged side by side, which, reflecting the sunlight with somewhat dazzling effect, remind him of the snowy scenes of winter. If all the tablecloths, sheets, handkerchiefs, and other linen goods passing through

the Works in a single year were sewn together, end to end, and stretched in a straight line, they would extend, so it has been calculated, the almost incredible distance of 10,000 miles; indeed, this estimate is believed to be rather under the mark. The operations of the Firm are so extensive that, including those engaged in the mill



and factory, and the weavers in their cottage homes, an army of over 7,000 people finds employment in the various departments of the business. In addition to the Glenmore Works, there are also large Works at

Millbrook, under the same management, which are kept exclusively for the finishing of goods. Linen and damask of every description are produced, whether by power or by the hand-loom.

The warehouse in Belfast belonging to the business has been described by a noted lecturer on architecture and taste in these words:—"Belfast has one beautiful building—I refer to the warehouse of

Messrs. J. N. Richardson, Sons, & Owden, Limited, which is beautiful in form and very beautiful in colour." This imposing structure, designed by Mr. Lynn, as a work of art, both inside and outside, is well worthy of inspection.

When the Prince and Princess of Wales visited Belfast in 1885, they were greatly interested, when going through the various departments, with the linen articles which were presented to them for their inspection. We give an illustration of the warehouse from a photograph by Mr. Church, taken when the Prince and Princess of Wales had stepped out on to the balcony to witness the vast assemblage and to bow their acknowledgments. The people of Ulster, to the number of 20,000, thronged the square below and greeted the Royal visitors with a mighty cheer.

As may be supposed, a successful business such as this is the result of individual enterprise and exertion. In the present instance, the success is due to the energy and good judgment of Mr. John Grubb Richardson

MR. JOHN GRUBB RICHARDSON.

(who is head of the concern) and of his brothers. Richardson's damasks obtained a diploma at the Centennial Exhibition for excellence and beauty, and Richardson's linens are a household word in Great Britain, America, and many other countries; in Australia there are agents for them in Melbourne and Sydney. With this Firm, as with typical firms in other branches of industry, the fame which has been achieved is the result of patient and never-flagging attention to detail, and to the most scrupulous care that every article offered for sale shall be up to the standard as regards quality and finish.

Belfast now contains a population of 240,000, as contrasted with 75,000 in 1837. The number of hands engaged in the linen trade, and the capital invested in it, have increased in proportion since Her Gracious Majesty ascended the throne.

Mr. Joseph Ball, Oldham.

THE manufacture and erection of lightning conductors, and the restoration of the lofty chimneys, spires, and towers with which our large centres of population abound, are branches of business not usually much thought of except by architects, or by those owning or in charge of such edifices; but when one of these has been struck by lightning, or has become so dilapidated as to be dangerous, and require repairing, then the importance of securing a man who is thoroughly and practically familiar with such matters to undertake the work is at once understood. Such a man, we believe, is the subject of our brief sketch, Mr. Joseph Ball, York Castle, Oldham, who is now well known throughout Great Britain and Ireland.

He commenced his dangerous craft as a climber at eight years of age, and many a time has he fallen from spouts and ladders, without venturing to tell his parents unless his injuries were severe. He was married at sixteen years of age, and commenced business on his own account in a cellar rented at 1s. 2d. per week. Having had no education at that time, he had to struggle on through great difficulties; but, after eighteen years of close and energetic application, he is now the largest employer of labour in his line of business. A marvellous change in eighteen years!

In 1869 Mr. Ball was man and master, whilst he now has about 54 men constantly at work in the making and fixing of lightning conductors on all kinds of residences, schools, church and chapel spires, and large chimneys, also in the pointing of decayed brick or stonework with his patent boiled oil mastic, and in the belting of the tops of other parts of large chimneys which are cracked. Building on new tops to spires or towers is a specialty of Mr. Ball's, also making and fixing vanes on the same. He has also had a very great deal of practice in straightening leaning and crooked chimneys, and of this kind of work we may instance the large destructor chimney of the Hull Corporation, 85 yards high, which was five feet out of plumb when placed in Mr. Ball's hands, but is now quite straight; the Stalybridge Spinning Company's chimney, 70 yards high, that was four feet out; the Silverdale Colliery Company's chimney, 70 yards high, five feet out, and the Rothwell Brewery Company's chimney four feet out. He has had charge of most of the largest and best chimneys which have been repaired during recent years, and among them we may mention the following:—that of Mr. S. C. Lister, Manningham Mills, Bradford, 85 yards high, with an opening of 14 feet at the top, which was pointed and had two new large copper tape lightning conductors fixed; that of Messrs. Schwabe & Co., Rhodes, near Middleton, 321 feet high, pointed and two large copper rope lightning conductors fixed; that of Messrs. Joseph Walker, Parker, & Company's Lead Works, Bagillt, Wales, 300 feet high, where the same work was done; that of the Tovil Paper Mills, Maidstone, 300 feet high; that of Messrs. Peter Dixon & Sons, Carlisle, 306 feet high; that of the London and North-Western Railway Company, Edge Hill, Liverpool, 303 feet high, along with many other chimneys belonging to this and other railway companies; that of Messrs. Langworthy Bros., Manchester, 303 feet high; and those of Messrs. Platt Bros. & Co., Oldham,

and Sir Elkanah Armitage & Co., Manchester. It is quite usual for him to build twenty yards on an old chimney without stopping the Works.

Mr. Ball frequently has men working in London, Ireland, Wales, and different parts of Lancashire and Yorkshire at one and the same time; and when, as often happens, the bulk of his men are at work within a moderate radius, he will ascend and inspect as many as ten chimneys in a day; in fact, he has been to the top of more chimneys than any other man in the business. With regard to consultations as to the building or repair of chimneys and the examination and testing of lightning conductors, Mr. Ball's services are very valuable, and having had such a practical and lengthened experience, he is able to point out all weak and defective places. The top of any chimney or spire 80 yards high can be reached by him in two and a half hours. He pays insurance for himself and men in case of accident, but has never had an accident caused by neglect on his part or bad tackle for his men to work with. All ropes, tackle, boards, ladders, &c., are carefully inspected before being sent out, and anything at all defective is at once destroyed without regard to possibilities or cost; in fact, everything supplied to his customers or used by his men is of the very best possible quality only; and it is this rigid adherence to excellence in workmanship and material which has gained him the confidence and support of so many of our best Firms.

The average number of accidents to buildings from lightning that occur in the course of a year has never been correctly ascertained; but in all probability it is far larger than most people suppose. Among the important English buildings which have been struck within the last few years, may be named the Parish Church at Stoke; the Old Hall at Lumley, where also seven persons were struck; the Tottington Mills near Bury; St. Botolph's Church, Cambridge; the Goods Station at Leeds; the Church of St. Helen's, where a man was blinded; the Church at Kingston-on-Thames; and St. Matthew's Church, Gosport. All these catastrophes to important edifices occurred in one year, 1882, and in England alone; nor is the above list by any means exhaustive.

It is a pity that people will not bear in mind, in the first place, that lofty buildings are exposed to considerable danger from lightning unless protected; and in the second that a lightning conductor should not only be set up, but should also undergo regular inspection by an experienced person if it is really to be thoroughly efficacious. This careful inspection is but very seldom attended to; and thus it comes about that chimneys and spires with lightning conductors are occasionally struck and the conductor or the man who set it up receives the blame which rightly attaches to the owner alone.

The Esher Linoleum Company, Royal Mills, Surrey.

ESHER or Ash-haugh, a pretty rural village in Surrey, pleasantly situated on the River Mole, is a locality of some historical importance, Esher Place, with its fine castellated gateway, having been built by William of Waynflete, Bishop of Winchester, and once occupied by the Great Cardinal (Wolsey). In the immediate neighbourhood is the Royal Palace of Claremont, now occupied by the Duchess of Albany. It was originally built and occupied by Vanbrugh in 1708; afterwards it became the property of Robert Clive, the hero of Plassey and conqueror of India; and in 1816 it was bought by the nation for the Princess Charlotte on her marriage with Leopold Duke of Saxe Coburg, the late King of the Belgians. Both Louis Philippe, King of the French, and his wife, Queen Amélie, died there. Adjoining is the Priory of Sandown, founded in the reign of Henry II., and united in 1436 to St. Thomas's Hospital, Westminster. In Sandown Park are held the fashionable suburban races, and from the grand stand, which is surrounded by about 150 acres, a magnificent view of the country for many miles round is obtained.

In 1876, in close contiguity to the London and South-Western Railway at Esher, an important Company was formed, now called the Esher Linoleum Company, for the manufacture of a comparatively new and important industry named "Linoleum"; new and expensive machinery and plant were laid down, the leading object of the proprietors of this Company being the production of a fabric of a high standard of excellence, and the cloth that is turned out by them is well and favourably known in the home, colonial, and foreign markets.

It is impossible to over-rate the importance of this fabric or the wide scope for its development in the future. For years previously the cold and comfortless fabric called floor-cloth had been used as floor-covering, but this new article, by its thickness, elasticity, warmth, and artistic designs, forms a good carpet in itself; in fact, it may be said to have nearly given the *coup de grâce* to the old floor-cloth fabric and many other floor-coverings. The uses to which it can be put are almost universal. It is suitable for halls, passages, staircases, bath-rooms, lavatories,—in fact, for every room in a house or an hotel, in some form or shape, either as mats or carpets. It is invaluable for libraries, public buildings, and Government offices, owing to its warmth and noiseless tread, and as surrounds to Oriental and other square carpets, being cleanly, easily removable, and waterproof, absorbing neither moisture, dust, nor dirt. It is also extensively used in the cabins and saloons of vessels belonging to various steamship companies.

These Works extend over several acres, which contain substantial cottages for the workpeople, a suitable residence for the manager, the necessary business offices, and other buildings. The River Mole, a tributary of the Thames, here forms a wide and important stream, and so constant and ample is the supply of the water that the Works are continually kept running by powerful water-wheels, steam power being only occasionally used.

The important constituents in the Linoleum fabric are:—cork, imported direct, in compressed bales, from Spain and Portugal; oil crushed from linseed from Russia; and kowrie and other gums from Australia and Africa. These are well blended together with colouring matter and other ingredients, and are then pressed by means of powerful calenders into a good, firm cloth, with a durable, waterproof canvas back. When the plain cloth is in the proper stage it is taken to the printing-room, where elaborate and beautiful designs are impressed upon it by means of blocks upon which the outline of the design has been clearly cut, each block being taken separately. This process continues until the whole of the cloth is blocked or printed; meanwhile, as the cloth is being printed, it gradually passes again into the drying-room, and remains there some weeks to season and mature, from which it is taken to the store and packing room ready for despatch either to the London warehouse, 35, Noble Street, E.C., for home requirements, or to the colonial and other distant markets of the world.

ESHER LINOLEUM WORKS.

The real secret in the production of high-class Linoleum consists in the proper oxidation of the linseed oil, and the length of time the "cloth" is allowed to mature in the various stages of its manufacture. "Time," and a liberal allowance of it, is the essential element of its success; and the attention of the general trade and public must be especially called to this fact, for cheap and worthless imitations are produced by hasty and excessive artificial processes, which make the cloth immature and not durable. This Company owes its great progress and well-earned reputation to the uniformity and durability of the cloths it has produced, as well as to the excellence and suitability of its designs and colourings, the credit of which is due to the energy and able management displayed by the staff, who have been connected with the Company since its commencement. The trade-mark of the Company is the well-known monogram (W. L.), with the words "Esher Linoleum" in the outer ring.

Atlas Engine Works, Bristol.

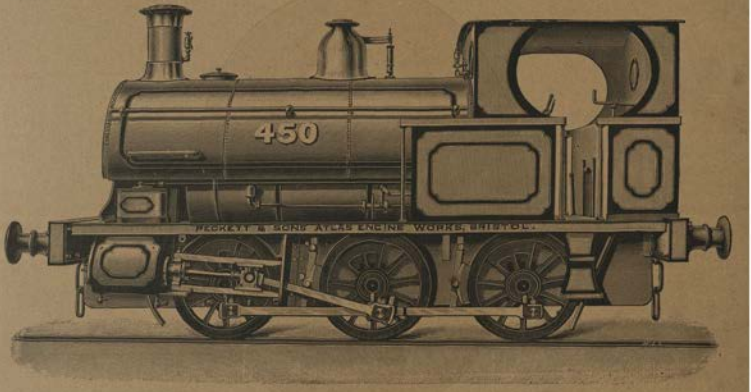
THOMAS PECKETT, the senior partner in this flourishing and rising Firm of Peckett & Sons, is a most enterprising man, thoroughly trained in all the various branches of his occupation, and takes great care that his sons follow in his wake. The four persons who manage this concern are Thomas Peckett, sen.; George T. Peckett, manager of the Works; John F. Peckett, the head of the clerks' and drawing offices; and Thomas Peckett, jun., who superintends the iron and brass foundries. The sons have been well schooled in all the different branches of the business, and know their work thoroughly. Mr. Thomas Peckett, the father, whose portrait we give in this notice, was apprenticed in Manchester, which, in itself, from the high standpoint that Manchester takes in producing machinery, is a recommendation. Mr. Peckett rose from the position of a journeyman to that of a foreman and general manager, and subsequently served in this latter capacity with Firms of considerable importance. In 1880 he bought the present premises, which had been carried on by Messrs. Fox, Walker, & Co., since 1864. Since then the business has greatly increased, and additions have been made to the Works; among these is a magnificent erecting-house, nearly 200 ft. long by more than 50 ft. in width, which will be mentioned again shortly.

In describing the premises, it may be well to begin with the offices, through which the visitor can approach the Works. They are extensive, and include draughtsmen's rooms. Here the drawings are carefully arranged and preserved in a fire-proof room, where, in the event of a conflagration, it is next to impossible for them to be destroyed. A book of duplicates, in reference to the drawings thus preserved, is kept as well, and a duplicate book of the duplicates also, with the same references to the drawings. Each of the books is preserved in a separate safe, so that, in case of fire or other mishap, at least one will be almost certain to remain unharmed. These books are so systematically arranged, and so well kept, that, should any particular part of a locomotive manufactured by this Firm, since 1864, be required by the party to whom the engine belongs, it can be supplied without the least difficulty, and without further drawing, measurement, or trouble to the maker or the owner. It will at once be seen how greatly the execution of orders for repairs is facilitated by this attention to method and system, since the customer has nothing more to do than simply to name the particular thing or part required. Roughly speaking there are about one hundred drawings for every type of locomotive made by the Firm, and these are arranged in about sixty or seventy classes, and kept in drawers in the fire-proof room. Tracings only are allowed for the use of the foremen and workmen. Photographs of the various types of engines, by good artists, are also to be seen in great quantities, kept on hand (classified) for the purpose of advertisement and for securing orders. It need hardly be remarked that this is done at a not inconsiderable outlay; but it seems that Messrs. Peckett spare no expense and trouble to bring their Firm into prominence. A visit to the drawing-room is highly interesting.

Passing through the offices we come to the Stores, well stocked with every necessary, including classified

bolts, nuts, pins, oil, bars, brass tubes, files, springs, and finished articles ready to hand. None of the workmen are allowed to take or remove any of the stores without a voucher from the foreman of his department.

Next we come to the manufacture of the locomotives themselves; and it will be interesting to know that every branch of the industry, excepting, of course, the manufacture of the raw material, is conducted on the premises. For the attainment of this end there are many separate shops or houses, including pattern-shops, plate-shops, iron and brass foundries, together with shops for the coppersmiths, the blacksmiths, the boiler-makers, and the grinders. There are also very large rooms for the machines of all the various classes required, as well as an extensive fitting and erecting, painting and finishing house; and last, but not least, there is a testing-house and a trial-ground. Here the new-made locomotives have to satisfy the proprietors before they are allowed to leave the establishment, which, by the way, is connected with the Midland Railway direct. A good reservoir of water is on the premises, and a colliery is close at hand, which gives a great advantage to the Firm in curtailing expenses. There are also residences for the foremen to the establishment, the buildings of which cover more than four acres. The average output for several years has been forty-nine locomotives per annum.



It will be best to describe the various shops separately, and in the order which we have adopted below.

The Pattern-shop is a commodious building, about 80 ft. long by 40 ft. in width. It is shelved all round, and in compartments may be found, classified, any pattern or model required for use at a moment's notice. These patterns and models are very numerous, and of excellent make and design, and must have cost no small sum of money. Another noticeable feature is the number of trollies seen all over the Works, which greatly facilitate the removal from one place to another of all the heavier portions of the engines being made. Railway metals, too, are laid in all directions with the same object, and afford an easy means of transit from one shop to another.

The Plate-shop is the building where the steel plates for making the boilers, tenders, tanks, &c., are stored, and an excellent stock of these plates is here deposited.

The Iron-foundry is an extensive one. The bulk of iron is the first thing that strikes one in connexion with this portion of the establishment. There are appliances for completing all the different kinds of castings, which, in locomotive manufacture, however, are not numerous, as by far the greater part of the work, whether of iron or of steel, has to be of wrought material. The cylinders are the most important castings, and must be without the least blemish. They are made of a special mixture of metal, used in these Works, of which

the Firm feel very proud. A ten-ton crane for moving and lifting these heavy goods is kept in this place, where is also a large drying-stove for drying the moulds of locomotive cylinders, &c. There are also two cupolas for melting the metal, one of which is of great size.

The Brass-foundry is also well fitted with every necessary appliance, and all the castings used are made here, special care being taken to mix the ingredients so as to form what is called gun-metal, another mixture of which the Firm are justly proud. Both the brass and the iron-foundry are superintended by Thomas Peckett, jun., who allows nothing but new metal to be used in either.

The Coppersmith's-shop is occupied by first-class workmen, and excellent work is here produced. The process of bending the copper tubes is highly amusing.

So busy a place is the Blacksmith's-shop that the din of the various anvils and the blows of the ponderous two-ton steam hammer almost deafen one. This large hammer can be and is regulated to such a nicety that even the shell of a small nut may be cracked without smashing the kernel. The large number of fires in the

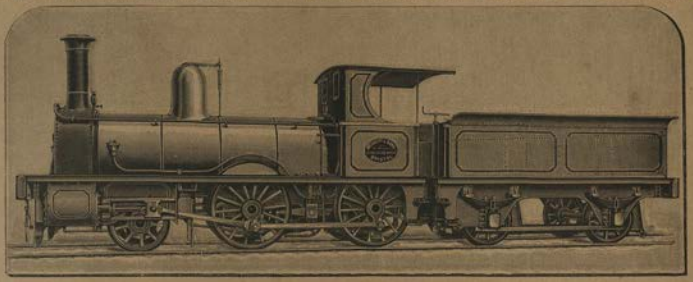
MR. THOMAS PECKETT.

forges give the place rather a warm temperature. Most of the important forgings are made by dies, and are completed at a single blow, thereby saving time and expense. The fires are kept to the required heat by blast power, which is driven by a No. 6 Roots blower. Of the numerous tools in use it is impossible to give any description; but we may mention that here, too, a good crane is kept, although the largest crane in the Works is to be found in the yard.

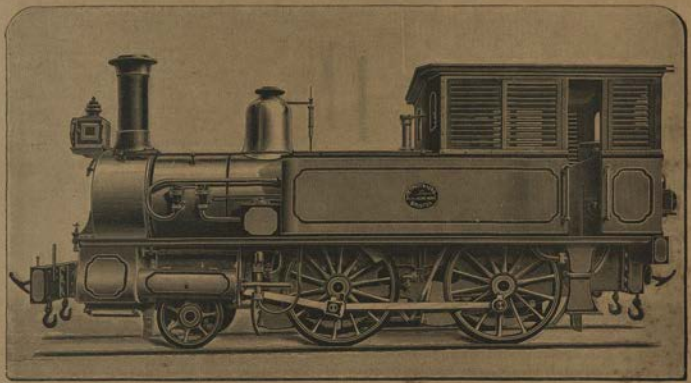
If the din of the smith's shop is great, the din of the Boiler-shop far exceeds it. Here may be found boilers in various stages of completion, of the best material, the fire-boxes being of thick copper. The noise made by the riveting is almost unbearable, and yet the men seem happy in their work. Machines for punching and shearing plates, &c., fitted with crane appliances, may be seen in constant use. The plates for the boilers are bent with plate-bending machines, which are somewhat curious to watch.

Perhaps the most interesting of all the houses or shops is the Machine-house. It is a large and lofty building, kept in the best order, well lighted, and thoroughly comfortable. The machines appear almost countless to the visitor, and are in beautiful working trim, designed on the automatic principle. It is observable that the hands engaged are men who seem thoroughly devoted to their employer and their work. Among the

numerous machines may be mentioned the radial drills, which are so constructed as to move to any part of the object to be drilled. A special class of machines are used for boring purposes, which may be seen in the act of boring the all-important cylinders. Wheel-lathes, for turning the loco-wheels and boring the tyres, and special lathes for turning the axles (which are all of the best steel), may also be seen. The next important



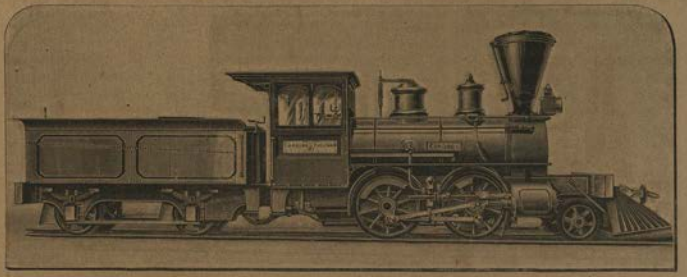
machines are those for planing, and of these there are numbers. The hard steel and iron appear to be as easily planed as wood is planed by the carpenter. The planing machines, which work automatically, almost without the aid of man, would fully repay a visit to the Works by themselves. Next, there are the slotting machines, which work vertically. The action is the reverse of the planing apparatus, and has longitudinal,



transverse, or circular motion, according to what is required; in this way great facility is gained in working the ins and outs of the different parts of the cranks, &c., of the locomotive. Then there are the shaping machines and the fixed drills. Besides these last-named machines, there are also slot drills at work, which, too, are on the automatic principle. Lathes for screw-cutting and similar purposes are also very busy, and, together with the lathes for finishing in gun-metal or brass, play an important part in this department. A vast number

of templates are arranged at the gable ends and sides of the building, and in this shop may be seen a large quantity of drawing tracings, actually in use by the workmen.

In the Grinding-shop the various parts that are not machined are ground, to take off the iron scale and



prevent oxidation or rust. Were this not done, the rust would form in a short time, and cause a blister on the painted work. Emery grinding machines are also to be found in suitable positions, and a number of men are employed in filing and preparing the work for the erecting-shop. A special machine for operating on

THE MACHINE HOUSE.

the large rough plates, and preparing them for the sides of the locomotive engines, has been set up in the yard.

A house called the wheel press is attached to the erecting shop. In this place the wheels are put upon the axles, and tested by hydraulic power, with a force of from sixty to ninety tons.

In the Erecting-shop may be seen many locomotives in every stage of completion. Several are standing ready for customers, like pianofortes in a music store, and, as soon as one is sold from the shop, another takes its place. This department really constitutes an immense show-room—200 feet by 50 feet—so lofty, well lighted and clean, that one is reminded by it of the Crystal Palace at Sydenham. Metals are laid in the building to suit all gauges, and no difficulty can arise in the erection of the engine. Some of the finished locomotives are really beautiful specimens of this important branch of industry, and are so painted as to be highly pleasing to the eye. They possess that important quality of compressed bulk, as well as the far more important quality of great power. A spacious paint shop is attached in a handy position for the use of the decorators, as also a depôt, where duplicates of finished parts of the locomotives are kept, ready for sending away at a moment's notice.

THE ERECTING SHOP.

The following are a few among the foreign countries to which the Firm have sent locomotives:—Sweden, Argentine Republic, Russia, Spain, Germany, Holland, South America, &c. They have also supplied locomotives to the English Government for various purposes, to railway companies, and to celebrated Firms, for their own immediate use in this country. Messrs. Peckett will welcome any visitors, be they buyers or not.

The success which has attended the Firm may be attributed to the skill and diligence of the managers, as well as to their theoretical and practical knowledge of their work, and to the straightforward and business-like manner in which the concern has been carried on. No piecework is allowed, as the proprietors are determined to avoid scamping, and to insure first-class workmanship. Lavatories and commodious stables complete the arrangements of the establishment.

Messrs. Peckett are about to erect two more very large shops, thereby pretty clearly indicating that their business popularity is on the increase.

Messrs. Dubs & Co., Glasgow.

THE locomotive engine, which has so completely revolutionised the carrying trade of the world, had its early home in Newcastle-on-Tyne, but for more than twenty years the city of Glasgow has been the head-quarters of its manufacture in the United Kingdom, and this change is owing mainly to the enterprise and the talent of the late Mr. Henry Dubs, whose portrait appears on the next page. Of German birth, Mr. Dubs permanently settled in this country at an early age, and, for a number of years, he held responsible positions in various locomotive factories in Manchester and district. In 1857 he became a partner in a Glasgow firm, which had previously made a few locomotives along with general engineering work; but, so great was his influence and success in developing that branch of the Firm's business to which he was specially attached, that in a very short time an entirely new and extensive establishment was erected, which was devoted exclusively to the manufacture of locomotive engines.

In 1863 Mr. Dubs severed his connexion with the Firm in question, and, establishing the new Firm of Dubs & Co., proceeded immediately with the erection of the Glasgow Locomotive Works, whose products have since then become so well and favourably known in every quarter of the globe. Profiting by his extensive experience elsewhere, Mr. Dubs designed and equipped a factory so complete and perfect in every detail that its general arrangements have never been surpassed; for years no alteration of any description was found necessary, while the extensions ultimately found requisite, owing to the exigencies of a growing business, have been carried out on the original lines with the most satisfactory results.

The business was from the first a great success, and though his colleagues were deprived of the services of their chief by death in 1876, his successors, who were his pupils, have continued it with results so satisfactory that it has greatly developed in their hands.

The primary object which the Firm has in view is to make their work of the very best possible description, and the workshop arrangements are all made to subserve this end, both materials and workmanship being systematically tested at every stage of progress. When an order is received, the initial stage of the work is executed in the drawing-office, where every part of the machine, to the minutest detail, is represented on paper before it assumes a more tangible form. The original drawings are all preserved in the office, and the tracings of these, which are sent out to be worked to in the different departments, are made by girls, who are accommodated in a separate apartment. Mr. Dubs adopted this method of getting his tracing work done many years ago, and thereby initiated a new and very suitable form of female labour, an example which has since been largely imitated.

The locomotive having thus assumed its first form on paper, the tracings representing the details are, in the first place, sent into the smithy and forge and the pattern-shop. In the former department are manufactured the wheels, axles, coupling and connecting-rods, shafts, levers, brake details, &c.; and to this is

devoted a variety of steam hammers of different powers, and the resources of a completely-equipped smithy with seventy-six fires.

The pattern-shop is furnished with various wood-working machines, and here are prepared the patterns for all parts that are to be cast in iron or brass, there being a foundry of each type immediately adjoining.

The boiler-shop is furnished with powerful overhead travelling steam-cranes, and with a number of hydraulic rivetting-machines and hydraulic cranes, so that the largest boilers are handled with perfect ease, and the work is carried on in comparative quietness. A special feature of this department is the number of drilling-machines it contains. Messrs. Dubs & Co., being satisfied that punching sets up an undue strain, and seriously reduces the strength of the plate, drill all their rivet-holes, and have, from the outset, made this a rule from which they never depart.

Adjoining the boiler-shop is a furnace-shop, containing a powerful hydraulic press, by means of which the heaviest plates are flanged at a single operation into the shape they assume in the locomotive.

MR. HENRY DUBS.

The most striking feature of this establishment is the machine-shop which, many years ago, was described by a professional authority as "one of the finest in existence," and which since then has been increased by 50 per cent. in respect both of dimensions and equipment. It is occupied throughout with the finest machinery it is possible to procure. Most of the tools have been manufactured by Sir Joseph Whitworth & Co.; and not a few of these, after twenty years' constant use, show no perceptible wear, and are in every respect as good as when they were first set to work. The machines are arranged in parallel rows, each row being driven by a separate engine, and are classified according to the work they have to do,—as turning, planing, milling, slotting, shaping, drilling, &c.,—so that the arrangement involves the minimum amount of moving of the work under manipulation. The rough work is all prepared for machinery in a special department, where the workmen mark off the finished dimensions on the castings, forgings, &c., from the drawings furnished to them, and in doing so they employ Whitworth standard gauges, the exact accuracy of which is carefully preserved by their being kept all the year round at a uniform temperature.

The result of this ensures such absolute uniformity of dimensions that the Firm can at once duplicate any part of any engine ever made by them, though the engine may be at the other side of the globe, and send out the part required, ready for fitting into its place, and for immediate use. This whole department is not only fitted with machinery of the finest description, but with power-cranes for carrying the work from one machine to another, and with every contrivance for economising labour and expense.

The organisation is, throughout, of the most perfect description, and there is the most careful sub-division of labour; no man, for example, ever leaves his machine to grind his cutting tools, there being a squad of men who do nothing else all the year round, so that the tools are always in the highest state of efficiency, and have constantly the same angles on their faces.

The whole of these varied operations find their consummation in the erecting-shop, where the various details are brought together, and the locomotive assumes the form with which the public is so familiar. For convenience in handling the engines in their complete form, this shop is fitted with a number of overhead travelling cranes, each capable of lifting 25 tons, so that by the use of two of them the heaviest locomotive can be lifted from the pit over which it is built to the rails running through the shop, and which are of every variety of gauge, and so transferred to the painting and packing shops. Before this transfer is made every engine is tested under full steam pressure; the boiler, before being put into the frames, having been previously tested in water and steam. In the painting-shop the engine receives its final touches, and, unless intended for a railway in England or Scotland, it is then transferred to the packing-shop, and taken to pieces and carefully packed for a sea voyage.

When the Works are run at their full capacity, the Firm employ considerably over 2,000 men, and manufacture four engines, with their tenders, every week. A specialty of the Firm is a combined locomotive and crane, designed by the late Mr Dubs, one of which they have had in daily use in their yard for twenty years, and of which they have sold a large number to railway companies, contractors, iron and steel manufacturers, &c. One of these engines was employed to arrange the contents of the Sydney Exhibition in 1879, and, being thereafter exhibited, was awarded a Gold Medal. It was afterwards bought by the railway department of the Government, which has since ordered two others; and so highly were the railway authorities of the neighbouring colony of Victoria pleased with it, that they lowered the barriers of their protectionist tariff to admit one of them, shortly after the delivery of the first in Sydney.

The business connexions of the Firm extend all over the world, for not only are their engines favourably known on every important railway in the United Kingdom, and most of the countries of Europe, but they are equally well known and appreciated in Canada, Chili, Brazil, the Argentine Republic, and the smaller States of South America; while in the Eastern Hemisphere their business has been very great. They supplied the India Government with the first engines ordered for the State railways, and they have sent many hundreds of locomotives to India and Burmah; they have also sent a great many to Japan, for which country, and also for China, they have, at the present time, orders in process of execution.

Such a trade as this is one with which any man may well be proud to be connected. Its operations in their beneficent results are daily adding to the comfort and convenience, and, consequently, to the happiness, of millions, while by facilitating intercommunication with the different nations of the earth, it strengthens the foundations of that material wealth on which the progress of the race so largely depends.

Messrs. Robert Stephenson & Co., Limited, Newcastle-upon-Tyne.

MANY as are the names enrolled in the Book of Fame of men who have stood forth as pioneers of industrial enterprise, there is none that can take precedence of those of George Stephenson and his son Robert, whose brilliant achievements in railway engineering have secured for them a foremost position among the benefactors of their race. In the introductory article to this volume, in which the development of some of the leading arts and industries during the past half century is briefly reviewed, reference has been already made to the benefits which have been conferred upon the nation by the invention of the locomotive. We who have been born in these happier days little realise, perhaps, what we owe to the man who brought the application of the locomotive engine to the purposes of railway traction within the range of practical possibilities, and who, in the face of untold obstacles and confronted by the most hostile opposition, never lost faith, but successfully accomplished the great object which he had set himself. The new method of locomotion called into existence by Stephenson has made its mark upon every phase and aspect of life. Whether regarded from the social or economical, the moral or financial point of view, railways have proved the most powerful factors for good in industrial and national history; they have improved and ameliorated the condition of all classes, from the highest to the lowest; they have contributed more than any other single agency to the progress of the nation, and they have brought in their train an increase of commerce and a growth of wealth that more than realise the fabulous riches of Eastern legends.

Like all great inventions, the railway system had a small beginning, and the tramways of the last century (contrived to facilitate the conveyance of coal from the collieries to the seashore) had but little practical value until there came upon the scene the Locomotive Engine, that crowning achievement of mechanical science. It is the object of the present article to trace the history of the Firm and business where the greatest of civilising agencies originated, and where the manufacture of locomotives has been since uninterruptedly carried on for a period of sixty-four years. As explained in the article to which we have already alluded, the Stockton and Darlington Railway was the first line opened, and by a special Act of Parliament, applied for at the instance of George Stephenson in 1823, the Company was empowered to work the railway by locomotive engines. While the building of this line was in progress, Stephenson continued to devote considerable attention to the improvement of locomotives, the future importance of which in connexion with railway enterprise he clearly foresaw. In 1825 the railway above mentioned was formally opened; but the employment of locomotives on this line was generally regarded as little more than an interesting experiment. Down to this time all the locomotives constructed after Stephenson's designs had been made by ordinary mechanics working at the various collieries in the north of England. He had, however, long realised that the accuracy and style of their workmanship admitted of great improvement; and he therefore, in conjunction with Edward Pease and Thomas Richardson, founded the celebrated engine works now carried on by the firm of Robert Stephenson & Co., Limited.

Stephenson's object in founding these Works was to concentrate under one roof a number of good workmen for the purpose of carrying out in detail the improvements which he was constantly making in his engines. Accordingly, a commencement was made in 1823 by purchasing a piece of land in Forth Street, and the building erected thereon formed the nucleus of the present huge establishment. It has been gradually extended on every side, absorbing houses and gardens, foundries, glass-works, and even whole streets. The factory forms a somewhat irregular figure, and covers about eight acres of ground, while the original Works extended altogether to less than one acre. The Works run parallel with the Central Railway Station on the south; they extend from Orchard Street on the east to Regent Street, near Forth Banks on the west, and stretch down to Forth Street on the north, by Sussex Street and South Street, both of which latter thoroughfares have been almost entirely absorbed by these great Works, which rank now deservedly as one of the sights of Newcastle-upon-Tyne.

MR. GEORGE STEPHENSON.

Actual operations were commenced in June, 1823; the first locomotive was made for the Stockton and Darlington Railway, and is still to be seen at the railway-station in Darlington, where it is mounted on a pedestal. As evidence of the small scale upon which the factory was originally worked, it is worth mentioning that the first fortnightly pay amounted to only £12. 2s. 2d., while now thousands of pounds are paid away fortnightly as wages. Owing to the hostile opposition manifested against the introduction of locomotives, the working during the first few years proved very discouraging. It was not until after the return of Robert Stephenson from South America, whither he had gone to superintend some important mining operations, that the Works may be said to have become successful. In 1829 the Directors of the Liverpool and Manchester Railway offered a prize of £500 for the best locomotive which should conform to certain specified conditions, and the elder Stephenson designed the famous *Rocket* for the contest. The Rainhill competition, and the marked superiority which it established of the *Rocket* over its three rivals, are matters of general knowledge and need not be enlarged upon here. The locomotive in question combined many novel and important features, and it says much for the scientific principles upon which it was constructed that in

the main it embodied the principal features characteristic of the locomotives of the present day. The inauguration of the Liverpool and Manchester Railway, for which the *Rocket* had been constructed, made the first great impression on the national mind that a revolution was taking place in the methods of travelling, and in the means for conveyance of merchandise. An important fillip was thus given to railway enterprise, and at the Works of Messrs. Stephenson were soon after turned out in rapid succession locomotive engines for the Canterbury and Whitstable, the Leicester and Swannington, the Stanhope and Tyne, the Chester and Crewe, and the Great Western Railway Companies, as well as for the Stockton and the Liverpool lines before mentioned. Foreign countries, too, soon ranked among the Firm's customers, and Messrs. Stephenson in those early days, even as they have done in more recent times, supplied engines to Continental as well as American lines. Seeing that the *Rocket* ushered in a new era in railway enterprise, it is worth recording that for a number of years it did regular service on the Liverpool and Manchester line. When afterwards

MR. ROBERT STEPHENSON.

superseded by heavier and more powerful engines, also built by Messrs. Stephenson, it was bought by Mr. J. Thompson, of Kirkhouse, in Cumberland, and was employed upon a colliery line. Finally it was presented by Mr. Thompson's son to the Patent Museum at South Kensington, where its contemplation cannot fail on the one hand to impress every beholder with the thought of what might have been the consequences to mankind if the *Rocket* had not clearly established the feasibility of locomotive traction on railways; and on the other it helps to recall to the mind the marvellous revolutions in every direction for which we are indebted to the Stephenson family.

In 1833 the first bogie engine was designed and constructed at these Works, this locomotive having been built for the Saratoga and Schenectady Railroad in America, and its design has been since extensively and successfully adopted wherever a railway route is intersected by sharp curves; the principle of the bogie in shortening the fixed wheel base producing a much steadier running engine than is otherwise obtainable. In course of time the locomotive was gradually improved by certain modifications and the addition of various parts, among the most important being the application of the "link motion" for working the slide valves; this was

the invention of one of Stephenson's pupils named Williams, and was worked out by William Howe, one of the foremen at the Works. The improvement has since been universally adopted in all classes of engines, both at home and abroad. It is indeed a noteworthy fact that a great and well-deserved prestige has always attached to the Newcastle Engine Works; and many of the most celebrated engineers of Europe and America have acquired here their practical training.

To describe the factory itself is a task to which it is impossible to do justice within the limited space at our disposal. It comprises large open yards surrounded by buildings which include forging and brass and iron casting shops, where the rougher portions of metal are prepared; filing and planing shops, in which the surfaces are smoothed and polished, boiler shops, fitting and erecting shops, pattern shops filled with thousands of patterns, storerooms, offices, &c.; the whole being planned with due regard to economy of time and labour during the manufacturing processes. Locomotives may here be seen in every stage of progress, and a visit to the Works, such as the present writer enjoyed, is of more than usual interest on account of the many associations connected therewith. A number of relics of early engineering are, moreover, to be seen here in the shape of drawings of some of the first locomotives ever built. Not only so, but the stationary engine constructed by George Stephenson in 1823 is still driving a portion of the machinery; the engine has, of course, been renewed in most of its details, but some of the original parts remain in good working order after the wear and tear of considerably more than sixty years.

Turning next to the productive capacity of the Works, we may adduce a few figures which, in their way, illustrate the marvellous development of locomotive engineering during the half-century of Her Majesty's reign. In 1830 eleven engines were built by Messrs. Stephenson; in 1840 that number was raised to forty-four; in 1860 to sixty-seven locomotives and fifteen marine and stationary engines. Since then the production has gone on increasing in a corresponding ratio, and no less than seventy-nine locomotive and eleven marine engines have been built here in a single year, in addition to which a considerable amount of repairing work was done in the same twelvemonth. Refraining, however, from going into further detail, we may sum up by saying that Messrs. Stephenson's Works have turned out altogether 2,650 locomotives, and nearly 400 marine, stationary, winding, and pumping engines, besides a very large number of boilers, bridges, dock-gates, &c., and the aggregate output represents a value of many million pounds sterling. Locomotives have been built here for nearly all the home railways, as well as for foreign railroads all over the world; large numbers having been sent to France, Italy, Russia, Egypt, India, Australia, South Africa, and America; while some have even found their way to China and Japan. Among the specialties of railway plant which have been produced, the elaborately-decorated engines and carriages built some years ago for the Viceroy of Egypt deserve to be mentioned. A locomotive constructed for the Midland Railway Company, and exhibited on the occasion of the Stephenson Centenary celebrations in 1881, was also a marvellous piece of work. The greatest achievement in this line is, however, the express locomotive now shown at the Newcastle Royal Mining, Engineering, and Industrial Exhibition. It has been specially built by Messrs. Robert Stephenson & Co., from the design of Mr. William Adams, for the fast main-line traffic on the London and South-Western line between London and Exeter. By way of contrast and for purposes of comparison with this mammoth engine, it is worth recalling that the original *Rocket* locomotive of George Stephenson had cylinders of 8 in. diameter, a 7-in. stroke, and driving-wheels of 4 ft. 8 in. diameter, and weighed altogether but 4½ tons. The new Express engine above mentioned, on the other hand, has cylinders of 18 in. diameter, a 24-in. stroke, four coupled wheels of 6 ft. 7 in. diameter, and a four-wheeled bogie. The six-wheeled tender attached to the engine carries 2,800 gallons of water and 3½ tons of coal. The total length of engine and tender is 52 ft., and their aggregate weight, when in working order, about 78 tons! Some further notion of the size and weight may be gathered from the fact that it took about seventy horses to convey the engine from the Works in South Street to the Exhibition building on the Town Moor. One of the great features of the *Rocket* was the improved arrangement of the blast-pipes; and, in the London and South-Western engine just described, another and superior form of blast-pipe has been adopted, which has been already in use on that railway for a couple of years, and has given excellent results in the more economical consumption of fuel.

In bridge-building, too, Messrs. Stephenson have achieved many triumphs of engineering skill, and, did space allow, we might enumerate a long list of important works of this class which have been carried out by them. Lately another new branch, viz., Shipbuilding, has been added to their extensive business, and to this brief reference must be made. Recognising the necessity of combining Marine engineering with Shipbuilding, the Firm, in 1886, acquired the ship-yard of Messrs. McIntyre, at Hebburn-on-Tyne, so that now the large

marine boilers and engines can be built close to the river, and the difficulty previously experienced in transporting them from the Works is thus obviated. In the same year the partnership was converted into a limited liability company, Mr. George Robert Stephenson being Chairman, and Sir J. W. Pease, M.P., Vice-Chairman; while the two sons of the Chairman, Mr. Robert Stephenson and Mr. George Stephenson, are the energetic Managing Directors of this large concern, which gives employment to about 1,500 workpeople.

Apropos of the subject of Shipbuilding, it may be added that the marine engines built at these Works have been of the most varied description, comprising engines for colliers, merchant vessels, trawlers, yachts, gun-boats, and ocean-going passenger-steamers of the largest and highest class. Several of the fine paddle-wheel steamers running in the service of the London and North-Western Railway Company, between Dublin and Holyhead, as well as some of the finest steamers trading between Liverpool, China, and the Brazils, have been engined at these Works; and it says much for the quality of the work turned out that boats engined here in the years 1852 to 1855 are still running, and doing excellent service with their original engines, the boilers having, of course, been replaced in the meantime.

From the foregoing notes some idea will be gained of the rise and development of a Firm, to whose founder the whole civilised world is indebted for one of the most widely beneficial agencies which have ever been evolved by man's instrumentality. The inventions of George and Robert Stephenson (excellent portraits of whom are given on two of the preceding pages) have placed within the reach of the human family what may be described in the words used by Dr. Johnson on a memorable occasion, as "the potentiality of growing rich beyond the dreams of avarice." Their townsmen have recognised this debt by erecting some years ago a statue to the memory of George Stephenson at a cost of £5,000; while the memory of his illustrious son is immortalised by his acts of princely liberality to every good cause which was brought under his notice. The names of both are moreover equally worthily perpetuated by the high repute as locomotive and marine engineers which the firm of Robert Stephenson & Co. has known well how to uphold under the successive administration of different generations of the same honoured family.

The London Necropolis Company, Woking Cemetery.

THE sentiments expressed in the old Latin sentences, "Mors omnibus communis"—"Mors janua vitæ," seem to afford us the key to a right appreciation of the subject of the Burial of the Dead. "Death is common to all," but it is no less true that "Death is the gate of life," and thus robs the "King of Terrors" of "the victory and the sting." But, leaving this high ground of Christian faith and hope, we must acknowledge the serious nature of the surroundings that attend the supreme event to which all nature flows, and notice the vast improvement experienced during the last fifty years in our manner of disposal of the dead and the growing consideration for the health, convenience, and sentiments of the living. Upon no subject have we a more ancient or interesting history, or, in fact, a more instructive one; and the first thing that its relation impresses upon the mind is the general consensus of opinion of all civilised, and even savage, peoples that it should take place far from the abodes of man. Abraham travelled through and dwelt in Haran, in the plains of Moriah, at Beer-sheba and at Bethel, but he purchased a grave at Machpelah, near Hebron, in the far distant land of Canaan, then a wilderness; and again Joseph's body was carried to the same country from the cities and country which had witnessed his greatest triumphs. But more pertinent reasons for removing the dead from the place of habitation is afforded by the laws enacted by Moses for the observance of such rites. The dead were put out of the camp, and many sanitary arrangements with respect to the mourners and those who conducted the burial—some of an onerous character—were enforced. Surely, this was done not entirely from mere ceremony, but mainly for the preservation of health and life. For similar reasons, no doubt, the tops of mountains were favourite burial-places. Moses, Aaron, Eleazer, and Joshua were not laid near inhabited places or near the altar of the Holy of Holies, but at the tops of the mountains Hor, Pisgah, and Ephraim; nor was any Jew buried in Jerusalem—the royal family alone excepted. Need we mention the well-known incidents of Lazarus, buried in a cave outside the village of Bethany, and of the son of the widow of Nain, whose body was being carried out of the city; nor do we find in any of the many wanderings of the chosen people that this custom was departed from. Coming to a later date, we find even the great founder of Christianity was, for three days, consigned to a tomb outside the city. But if the records of the Israelites are, for their age, most reliable, their customs in this respect are by no means singular. Need we refer to the ancient Egyptians, whose reverence for the dead displayed itself both in an anxious desire to preserve the body by the system of embalming and in perpetuating their memory by the erection of tombs of unexampled grandeur. What in the world can compare with the Pyramids, with their surrounding monuments forming cities indeed, but cities of the dead, around which no sign or trace of the habitations of the living have been found; grand in their isolation no less than in their imposing magnificence, but placed at long distances from the centres both of government and of active life. The Persians buried even monarchs at the top of a hill, on the east side of the city of Persepolis, and there is now no graveyard in Ispahan, or in any city

of Persia or the Levant. The Greeks, with the very rare exceptions of a few eminent men, were buried beside highways, and we read that at Delos neither births nor burials were allowed to take place in the city; and, so fearful of contagion were the inhabitants, that no man was allowed to go to the distant sepulchres except on the occasion of a funeral, and no burial was permitted to take place on fruitful ground. The Romans followed the same custom, with the exception of emperors and vestal virgins; and even when cremated the process took place at a distance from the cities, in fields near highways. Even Julius Cæsar was buried at Rome by special favour. Turks, Mahometans, and Chinese alike bury away from towns and cities, the last, as far as practicable, on the tops of hills, and often at long distances from habitations.

Early Christians followed this (until their time) universal practice; and the first intimation of burial in churches is a decree of Charles the Great against the practice, which must therefore have been known only a little before the eighth century, although the practice of consecrating ground was first instituted in the sixth century. The catacombs where they were buried are three miles from the Capitol. In Britain, in the seventh century, bodies were interred in cities; but it was by licence of the Pope in 798 A.D. that churches and

THE LONDON NECROPOLIS, OR WOKING CEMETERY, BROOKWOOD, SURREY.

churchyards were used for that purpose, and the practice, although forbidden in the reign of William the Conqueror by a council presided over by Lanfranc, Archbishop of Canterbury, prevailed for more than eight centuries. The custom was fostered by pride and ambition, superstition, and for gain. At first only privileged persons and ecclesiastics found a resting-place in chancels and other parts of churches, and this led to a superstitious belief of the super-sacredness of such positions; but perhaps that which most led to the practice was the enrichment of the priesthood by the large sums paid for such positions, which soon became assessed according to wealth or dignity. To be buried in cloisters was to have the benefit of oblations, mortuaries and prayers, masses and indulgences; and this was so impressed upon the laity, even to the impoverishment of the donor that an eminent critic of that day says: "Rejoice over the iniquities of the sons of men, which bring so much profit to thee."

But there are other and more mundane reforms than those above indicated. Churches became charnel-houses; nor was the position much improved when the yards attached thereto became so crowded as to make their description most revolting, nor is it too much to say that to such causes may be traced not only the

most virulent but the most lasting plagues that have afflicted humanity during the Middle Ages. In many of them this was the condition when Her Majesty commenced her reign. Many Burial Bills and Acts of Parliament have since been passed to remedy these evils, especially in the years 1852, 1853, and 1855, all of which enacted a return to the early customs of extra-mural interment. In the meantime, cemeteries that only imperfectly, even at their formation, complied with these conditions, have been in turn included in this great Metropolis, so that we choose for this illustrative notice that at Woking, as fulfilling every condition of rational, respectful, healthy, and decent burial; attractive instead of repulsive, and associating the last resting-place of those we love with calm and pleasant scenes, "far from the busy haunts of men."

For another reason we choose the London Necropolis, as it is called, which is, that the Company have successfully battled the abuses that, like weeds, choked every sentiment of rational sorrow. Instead of the dismal hearse, the solemn mockery of mutes, the weary journey through crowded thoroughfares, and the extravagant expenditure involved therein, they have, in connexion with the London and South Western Railway Company, provided for the removal of the corpse and of the mourners to reception-rooms at their private station in London, or at the Cemetery, where the mourners can meet instead of at the dwelling-house of the deceased, thus avoiding that distressing scene with which most of us are too familiar; and, by their system of what is called the Earth-to-Earth burial in perishable coffins, assure a progressive resolution into its original elements of the "house of clay" in a soil adapted thereto. Earth, the natural destination of all organised bodies that have lived, is admitted to be the great purifier, and the principle of burial supposes the resolution of the body by the agency of the earth to which we commit it, and the earth is competent to effect that resolution, and to effect it innocuously.

But the Company not only provide for decent burial and for the health and comfort of the mourner, but have made the last resting-place one of beauty, such as the mind loves to rest upon in fond recollection. They have chosen and purchased 2,000 acres of land, 500 of which are enclosed and planted at Woking Common, situated in one of the most lovely counties—Surrey—famous for its extensive and picturesque scenery. Situated in the midst of an elevated plateau, the Cemetery has been planted with trees, flowers, and shrubs, and laid out with winding paths that happily break the dull monotony of the ordinary graveyard. Beside broad roads, stately avenues of coniferæ lay back amongst the purple heather. The Wellingtonia gigantea, of which there are grand specimens, are interspersed with the graceful Deodara, beautiful Lawsonii, and the prickly Chili pine, laying against a rich background of Scotch fir and Irish yew, whilst large beds of rhododendron and small clumps of roses in the foreground, add charm to the scene. Ankle-deep in heaths of various kinds, plots of ground encircled by laurel hedges are apportioned to various parishes of crowded London and Westminster, St. Ann's, St. Margaret's, and St. John's, Westminster, St. Alban's, Holborn, and St. Saviour's, Lambeth, being amongst the chief; and one for the Danish and Swedish, and another for actors form specialties, as well as one for the Romanist communities. Whilst no less than 105,000 interments have been made since the Company first obtained their Act of Parliament in 1852, so dispersed are the tombs, monuments, and mausoleums amongst sylvan glades, that they add to their effect and heighten the contrasts of light and shade. The church and chapel in the consecrated and in the unconsecrated grounds are of simple Gothic architecture, partly ivy-covered, and in other parts chapels-of-ease are conveniently placed, for the service in which the Company have secured duly qualified clergymen and ministers.

It would not be just to overlook a gentleman to whose earnest advocacy the results we have indicated are mainly due. Mr. Francis Seymour Haden, both in the *Times* newspaper and by the publication of tracts, has awakened and guided public opinion on this subject. He says:—"Some curiously mistaken notions exist as to what happens to a dead body when, in the words of the old ritual, it is 'laid into the ground,' the popular notion being that it becomes a part of that clay to which it is committed. Nothing of the kind. A body properly buried—buried, that is to say, in such a way that the earth may have access to it—does not even remain in the earth, but returns to the atmosphere. Let me explain. Suppose a body buried three or four feet below the surface, the earth, as earth, affects it in no way whatever. The part played by the earth in its resolution is that of a mere porous medium between it and the air which is above it. Through this medium this air, with its dews and its rains, filters, and, when it reaches the body, oxidises it—that is to say, resolves it into new and harmless products; and then these new products, passing upwards again through the same sieve-like medium, re-enter the atmosphere and become the elements of its renewal, and of the nourishment and growth of plants. The body, in fact, literally, as well as figuratively, ascends from the dead and fulfils the cycle of its pilgrimage by becoming again the source and genesis of life. Is it possible to

conceive a provision more beautiful, more benign, more suggestive, not of gloomy, but of elevated and consoling trains of thought?" His allotment in the Cemetery has a very pretty and unique appearance.

With such surroundings to alleviate natural grief, may we not feel that, as the Laureate of this Jubilee Reign has expressed it, the predominant feeling will be—

"This truth came borne with bier and pall,
I felt it when I sorrow'd most;
'Tis better to have loved and lost
Than never to have loved at all."

The interest taken in this movement, so essential to the health and well-being of the whole community, may be shown by the fact that the following gentlemen have accepted Legislative authority to act as

Visitors

(APPOINTED BY PARLIAMENT).

THE LORD-LIEUTENANT OF MIDDLESEX.
THE LORD-LIEUTENANT OF SURREY.
THE LORD BISHOP OF LONDON.
THE LORD BISHOP OF WINCHESTER.
THE LORD MAYOR OF LONDON.
THE CHIEF COMMISSIONER OF HER MAJESTY'S WOODS AND FORESTS, &c.

The directors and officers are:—

Directors.

WILLIAM AUSTIN, ESQ.
CHARLES EDWARD AUSTIN, ESQ.
SIR THOMAS DAKIN.
REV. LOGAN LOGAN.
HENRY CADOGAN ROTHERY, ESQ., F.I.S., M.R.S.I., F.R.M.S.
COLONEL ALFRED TIPPINGE.
HORACE WILKINSON, ESQ.
SIR RICHARD HENRY WYATT.

Secretary—JULIAN LARKMAN, ESQ.

Manager at the Cemetery—MR. BARRATT.

OFFICE—2, LANCASTER PLACE, STRAND.

Messrs. E. Packard & Co., Ipswich.

OF the many new industries that have been introduced during the last fifty years there are but few that have assumed such extensive development and universal adoption as the manufacture of Artificial Fertilisers. The discoveries of science that led to the possibility of making Chemical Manures have caused as great a revolution in agricultural procedure as railways and steamships have in the transit of goods.

If the name of Lawes is celebrated for investigations into the effect of chemical substances upon agricultural produce, that of Packard is not less recognised as the pioneer of those economies, mechanical adaptations, and chemical operations that have brought to perfection the enormous industry of the manufacture of Fertilisers, which, owing to great local advantages, still has its centre in England, whence the produce is exported to all the most advanced agricultural districts in the world.

The Ipswich Firm of Edward Packard & Co. was founded by Alderman Packard, J.P., D.L., who made the first experiments in dissolving the coprolites of the Suffolk Red Crag, and with such success that very soon the experimental Works had to give place to the large factory near Ipswich specially designed for the purpose, and from which manures of all descriptions, and suitable for all kinds of Home and Colonial crops, are delivered. Mr. Packard employs vast numbers of hands not only in these Works and in mining for coprolites in Suffolk and Cambridgeshire, but also at important branch manufactories in Ireland and Germany, and extended his operations for the production of phosphates to Germany and France. In the later developments of the business he was aided by his sons, Messrs. Edward and Henry Woods Packard, who, on the retirement of their father from the Firm in 1886, assumed the proprietorship of this vast undertaking, and upon whom for some years previously had rested the responsibilities of the active management of the business.

It has been their pride to be foremost in all the great advances that have been made both in the scientific principles and practical details of the manufacture of artificial manures, ever pressing on to obtain the highest possible qualities and to introduce the greatest economies into the various processes. The first to combine with the business the manufacture of sulphuric acid, which is so important a factor in the production of manures, so, too, were they ever foremost in introducing and adapting new raw materials, gradually improving the ordinary methods until they evolved that marvellous process by which their now well-known Patent Concentrated Superphosphates are made: these contain no less than 50 per cent. of soluble phosphoric acid, and it has been proved to demonstration that the most soluble manures, ammoniacal or phosphatic, yield the most economical result on the soil. The knowledge thus gained led to further investigations culminating in the taking out of an important series of additional patents.

In 1880, some improvements in the manufacture of sugar, which bid fair to revolutionise that industry, were effected in the Mauritius by Monsieur Leon Ehrmann, the chief feature of which consisted in the application of phosphoric acid for the clarification of sugar-cane juice. This discovery has had an important

bearing on the development of the Ipswich manufactory, since, by an interesting coincidence, at the very time when phosphoric acid was wanted as a commercial commodity at a reasonable price, in order to render the new sugar processes an economical success, Messrs. Packard were in a position to supply the article in a portable form, exactly suited to the requirements of sugar factories, and called "Ehrmannite," after the before-named gentleman. By these means sugar of the finest quality is now produced, without the aid of the refiner, upon the estate where the sugar is grown, many expensive details of the old system being dispensed with, and a larger yield of sugar, at the same time, being obtained. When it is mentioned that this year (1887) Messrs. Packard have at their sole expense induced Monsieur Ehrmann to visit the British West Indies, in order that the advantages offered by these new systems of making sugar may be extended to all parts of the Empire, our readers cannot but agree that such public spirit on the part of the Firm, deserves the success which must undoubtedly follow in the increased demand for their manufactures. Already nearly all the factories in Queensland are using the process

MR. E. PACKARD, JUN.

to their great advantage. An experimental farm is ably conducted at a considerable annual outlay, and much useful information obtained, from which is formulated the composition of the manures provided by the Firm for home produce.

In the midst of all the work naturally devolving upon one who takes a leading part in the conduct of such a large undertaking, Mr. E. Packard, jun., has not neglected the duties of citizenship. He has for many years been an active member of the municipal corporation of Ipswich, and was the founder of the Ipswich Chamber of Commerce and of a successful and large Conservative Club. He also established in the town an Art Gallery, where annual exhibitions are held, and which has immensely developed the latent taste and talent for art in the county which produced Gainsborough and Constable. In recognition of these public services, Mr. Packard was unanimously elected Mayor of Ipswich in 1887, the fiftieth year of the Queen's reign.

All the Highest Awards have been received by the Firm at the various International Exhibitions.

Messrs. Alfred Jeffery & Co., London.

THE late Mr. Alfred Jeffery, whose portrait we have placed on the next page, was engaged about the year 1840 endeavouring to make a good anti-fouling composition for ships' bottoms when he discovered the valuable material which he then named "Marine Glue," and with a conviction,—produced not by the enthusiasm of an inventor, but with calm consideration and the chemical and practical knowledge of several scientific men,—that this new composition, to the perfection of which he had devoted considerable time, would become of immense advantage in Shipbuilding purposes, he conceived that it would be beneficial to the State and honourable to himself to offer his invention to the Admiralty.

With this view he communicated with the Earl of Minto, at that time the First Lord of the Admiralty, offering to give the public the benefit of his invention, and to attend at the Royal Dockyards himself for one or two years to give necessary instructions, and watch the careful application of the material; and, that if his invention proved to be advantageous to the public service, he should be satisfied to receive the reward the Admiralty might consider it merited.

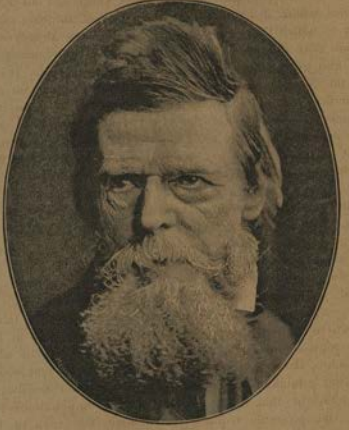
The Earl of Minto, after giving this proposition his consideration, saw difficulties which made such an arrangement impracticable, and recommended Mr. Jeffery, therefore, to send the particulars of his invention under seal to the Record Office of the Admiralty, and to protect himself by Royal Letters Patent. This advice Mr. Jeffery followed to the full.

Many experiments and severe trials were then made by order of the Government to test the qualities of the Glue, and a Committee of Master Shipwrights from the Royal Dockyards, convened at Woolwich in 1842, unanimously reported to the Government that they had "become fully convinced, not only of its advantages in paying seams, but of its invaluable properties for other purposes"; and stated that "they considered it would prove one of the most important discoveries for shipbuilding of modern times."

For the next five years Mr. Jeffery persevered unceasingly to surmount the many difficulties, obstacles, and prejudices that beset him at every step, that he might ultimately and satisfactorily establish this important invention in H. M. Dockyards; imposing on himself unnecessarily painful delay, upwards of seven thousand pounds expense, and immense personal sacrifice, through forsaking his profession as an artist, that the Government might not lose the advantages the invention afforded. At length, in 1846, so many proofs in favour of the Glue had accumulated, that it was admitted on all hands to be incomparably superior to pitch or resin for paying seams of decks; and in October of that year Mr. Jeffery, considering that it had been adopted by the Admiralty, applied for compensation for time and capital expended. But no satisfactory reply being received to this or to a further application, the matter was brought before the House of Commons on April 12, 1847, by Capt. Pechell, R.N., who "asked the Secretary to the Admiralty what course had been adopted with respect to a very valuable invention produced by Mr. Alfred Jeffery, applicable to the caulking of ships, viz., Marine Glue? It had

been applied to the decks of several of our ships sent to hot climates, and they had been very much benefited. The necessity of having the decks caulked every two or three years had been done away with, and he believed if the material were brought into use throughout the Navy, a saving of from £20,000 to £50,000 a year might be effected. But as to the advantages to those on board the vessels sent to warm climates, every one must be aware of the excessive annoyance arising from the pitch used in ordinary caulking becoming soft and clinging to the feet; and when the comfort of those who were obliged to sleep upon the deck was considered, the advantage arising from the use of the Marine Glue must be evident. For the last hundred years no improvement had taken place in the materials used in caulking; he therefore trusted that the Honourable Secretary to the Admiralty would tell the House what course was about to be adopted with reference to the material, and also whether the gentleman who invented it was to be rewarded."

Mr. Ward replied "that the Marine Glue had proved to be exceedingly satisfactory in its application. He



MR. ALFRED JEFFERY.

had seen experiments that day where it had been applied to vessels which had been exposed to the warmest climates, and the result was extremely successful. The inventor was unquestionably entitled to compensation; and he hoped that at some future day the House would take the question of remuneration into favourable consideration."

In the face of all this, however, and of the great value gained by the Government compared with the moderate claim made, further applications by Mr. Jeffery failed to gain him more than a small royalty for superintending the manufacture.

To illustrate the care and experience necessary in its manufacture, at one time the Dockyard authorities decided to make the Glue themselves, paying a royalty only; but although profiting from the instructions of Mr. Jeffery they failed, and thenceforth it was supplied from the inventor's Works at Limehouse.

The *Times*, *Shipping Gazette*, *Colburn's United Service Magazine*, and the general Press took a great deal of interest in the invention, and we have seen testimonials from officials and public men too numerous even to

specify; but we may mention out of curiosity one from Isambard Brunel, dated "Tunnel," November 18, 1842; and one from Admiral Sir E. Codrington, who anticipated that the discovery would cause the greatest improvements in public and private works,—an anticipation which has been, and is still, fulfilled to the letter.

The Exhibition of 1851 found Mr. Jeffery with characteristic energy again well to the front as an exhibitor, where specimens of the application of his invention excited much interest and gained him the Prize Medal. In 1857, owing to the Indian Mutiny, the supply of shellac (an important ingredient in the Marine Glue) was almost stopped, enhancing the cost of the Marine Glue so much that Mr. Jeffery immediately endeavoured to neutralise this, and after many experiments he solicited the Admiralty to allow him to supply a cheaper article composed of his Patent Marine Glue and Vegetable Pitch in equal proportions. The Admiralty agreed to this, and the Marine Glue Pitch gave so much satisfaction that it was ultimately adopted for deck seams, and to the present day is exclusively used in the Royal Dockyards, and is specified in all Government contracts.

The rise of Telegraphy has created a great demand for the Marine Glue owing to its splendid insulating properties and ease of application. It is adopted by H.M. Post Office and all Railway Companies for coating the interior of galvanic batteries, where it has to resist the action of sulphate of copper and other salts.

The numerous purposes to which this Glue is applied besides those already alluded to, we have no space to detail; but we may mention that it is used for hospital, barrack, and brewery floors, being clean, and a disinfectant; also for joints of iron gutters, for iron bridges, pontoon boats, &c. It is equally interesting to learn that it has been adopted by the National Lifeboat Institution from the first, for airtight cases, compartments, and bulkheads throughout their fleet. Again, in combination with calico or canvas, it is applied for waterproofing packing-cases for bright machinery, as specified in the Great Indian Peninsular and other Railway contracts; for tops of tram-cars, railway and other carriage roofs and bodies, giving an indestructible and waterproof lining. An ingenious application of it in this manner has been invented by Mr. J. S. White, the well-known yacht builder, of Cowes, for producing a waterproof and elastic skin between the plankings of his diagonally-built steam pinnaces and launches.

The Patent Marine Glue is clean, no yachtsman would think of having any other material in his deck seams; it is insoluble in water, elastic, a disinfectant, and a non-conductor; it will attach india-rubber, gutta percha, leather, cork, fibre, &c., to wood, metals, glass, or other substances; a specially fine transparent quality is made for photographic and microscopic work. A Patent Marine Glue Varnish is made which answers some purposes for which the Glue would not be available.

These varied uses, and the greatly extended employment of the Glue by Colonial and Foreign Governments, and shipbuilders, and others, necessitated the removal of the factory to larger premises at Stratford, London, in 1882, where continual improvements in plant, and care in the manufacture, enable the present Firm to maintain the high character of the invention; as a proof of which, in 1884, at the fourth International Exhibition of London, the Patent Marine Glue was exhibited and obtained the Gold Medal.

In 1854, Mr. Jeffery having established the value of his Patent Marine Glue, turned his attention to the question of rifled ordnance, which to that time had been found impracticable owing to the difficulty of attaching the lead portion of the projectile required to transmit the twist of the rifling, the consequence being that neither the direction nor the range of the shot could be depended upon, the result of several experiments causing great doubts as to the practicability of making effective shot for rifled ordnance. Mr. Jeffery submitted a plan to Her Majesty's Government offering to pay for the gun and projectiles if it proved to be unsatisfactory, only stipulating that if good results were obtained he should be recompensed; and the Select Committee at Woolwich then offered him every facility for having it tested at the long range at Shoeburyness. He, therefore, had twelve shot cast under his superintendence and upon his own plan, which were all fired, the practice being at two ranges fifty yards apart, the extreme range being 1,700 yards.

Mr. Jeffery's shot were all cast for the bore of a nine-pounder gun, but, being conical, and varying in length, they weighed from 12 lb. to 14 lb. each. The line of firing was very good, and in almost every instance the shot went beyond the target. All were fired, the last being at an angle of 10 degrees, with a charge of but 2 lb. of powder, and it made a range of upwards of 3,000 yards before it struck the ground. The plan devised was extremely ingenious yet simple, the lead being dovetailed in such a manner that the pressure of the gas tightened the joints, and forced the metal into the rifling grooves. The projectiles recovered afforded sufficient evidence, the *Army and Navy Gazette* of 2nd October, 1854, stated, as not only to have overcome the difficulty before existing, but to have established a new principle in the construction of shot adapted for firing from rifled ordnance.

Messrs. Bryant & May, Limited, London.

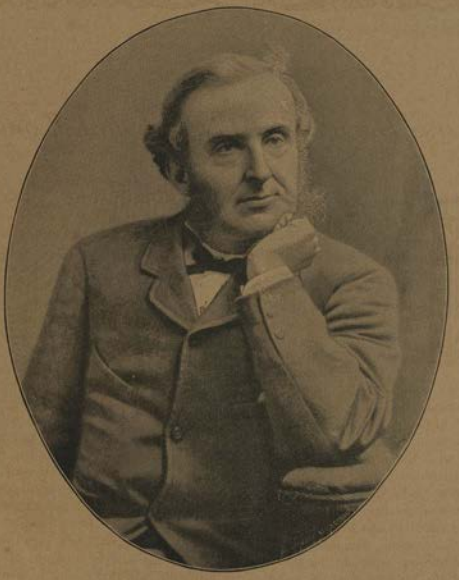
NO savage tribe seems really to have been found so low as to be without fire. The way in which the lowest tribes of the human race understand fire, contrasts the intelligence of man with the dulness of even the highest apes. There is an old story how, in the forests of equatorial Africa, when travellers had gone away in the morning and left their fires burning, the huge man-like apes, called pongas (probably our gorilla), would come and sit round the burning logs till they went out, not having the sagacity to lay more wood on. Of course, there had been forest fires in ages before man, as when the trees had been set in flames by lightning, or by a lava stream. But, of all creatures, man alone has known how to manage fire, to carry it from place to place with burning brands, and when it went out to produce it afresh. In the limestone caverns, among the relics of the mammoth period, morsels of charcoal and burned bones are found embedded, which show that even in that remote antiquity the rude cave men made fires to cook their food and warm themselves by. As to the art of producing fire, the savage way was mostly by the friction of two pieces of wood, and to this day travellers may now and then see the simple apparatus at work. According to Tylor, the eminent anthropologist, the hand fire-drill consists of a stick like an arrow, cut to a blunt point, which is twirled like a chocolate muller between the hands (shifted up when they get too far down) with such speed and pressure as to bore a hole into an under piece of wood till the charcoal dust made by the boring takes fire. For easier working, some nations have long had a mechanical improvement on the simple savage fire-drill, by driving it with a thong wound a couple of turns round the stick and pulled to and fro.

Among civilised nations, the old fire-drill had already in ancient times been superseded in common use by better contrivances, especially the flint and steel. The fire-drill is a means of converting mechanical force into heat till the burning point of wood is reached. But all that is really wanted is a glowing hot particle, or spark, and this can be far more readily got in other ways. It was known to some modern savages, even the miserable natives of Tierra del Fuego; to the pre-historic men of Europe, as appears from the bits of pyrites found in their caves; and, of course, to the old civilised world, as witness the Greek name of the mineral, *pyrites*, or "fiery." Substitute for this a piece of iron, and we have the flint and steel, the ordinary apparatus of nations from their entry into the iron age till modern times. Yet even this has now been so discarded that the old-fashioned kitchen tinder-box, with its flint and U-shaped steel, has become a curiosity worth securing when found by chance in some farm-house. The burning-lens and the concave mirror were known in ancient Greece. The Chinese used the wooden condensing syringe.

The lucifer match dates from about 1840, but the original match was a very poor contrivance compared with the cheapest "lucifer" of the present day. One of the first manufacturers of lucifer matches was the late Mr. William Bryant, of Plymouth, who was the founder of the great Firm known all over the civilised

world as Bryant & May. When Mr. Bryant's four sons were old enough, they assisted their father in the development of the match trade, and the present Chairman of the Board of Directors of Bryant & May, Limited, is Mr. Wilberforce Bryant, the gentleman whose portrait we give below. Bryant & May's celebrated Works are situated in Fairfield Road, Bow, and cover about ten acres of ground; the frontage is handsome, and every workshop and store is substantially built and literally fire-proof.

A large number of women and girls are employed at the Fairfield Works, and their appearance certainly belies the reports which have from time to time been circulated about the "poor matchmaker." A sturdier or



MR. WILBERFORCE BRYANT.

healthier-looking set of workwomen we have seldom, if ever, seen. Many of them would have been more than a *match* for the average male artisan. They worked with an energy that would do our domestic servants good to witness. Of course, they are all on piece-work, which is the fairest arrangement both for employer and employé. They earn double, and sometimes treble, as much as the pale-faced Lancashire mill-hands, who really deserve some of the sympathy which is wasted upon the girls who work at matchmaking. In most books on arts and manufactures the authors state that a great deal of human suffering is always to be found in a lucifer-match factory, and the general impression is that the match-girl dies prematurely from the effects of the phosphorus used for tipping the splints. This is an old-fashioned idea, founded on fact, no doubt, but wholly without truth at the present time. In the early days of matchmaking a man and a few children

worked in a wretched garret, and the quantity of phosphorus employed was large; indeed, the tip of the match contained little else than the pure element, which, doubtless, had an injurious effect upon the workpeople; but now, what with the marvellous strides made in chemical science, and the introduction of labour-saving machinery, a match factory is healthier than many of the places where articles of food are prepared. We have seen with our own eyes the strapping lasses of the largest match factory in Great Britain, and we can assure our readers that it is a great waste of sympathy to pity the employés of such a Firm as the subject of our notice.

At the Fairfield Works a most perfect system of ventilation has been adopted; the roofs of the buildings are arranged so that any one can walk about on the leads with ease. The tops of the air-shafts are covered with movable contrivances to regulate the admission of the air, according to the season of the year or the temperature of the atmosphere. There is nothing stuffy about any of the workshops, which, to a certain extent, may account for the healthy condition of the male and female operatives. The manufacture of matches is a most interesting process. A portion of the timber used by Messrs. Bryant & May is cut into splints in Canada, and sent over to this country ready for converting into matches; but the greater portion of the pine-wood is sawn and cut at their own saw-mills and box-works on Bow Common. No timber is cut or stored at the Fairfield Works, where the inflammable components are made and used. The wood is sawn into blocks to fit the splint-cutting machine, which consists of a guillotine knife and a set of lancets. When the wood is cut into splints it is tied into bundles, and thoroughly dried by being left in a heated chamber for a considerable time. The dried bundles of splints are then sent to Fairfield, where they pass through one of the prettiest automatic machines we have seen. The splints are filled into frames by this machine, and afterwards dipped into melted paraffin wax.

They are then passed on to another hand, who strikes the splints in the frame, with a weight to drive the ends of the splints into an uniform position for dipping. Each splint is double the length of an ordinary match. The two ends are dipped in the composition, and, by another ingenious machine, the made matches are released and the splints or double matches are transferred to a girl, who picks up the right quantity to fill a couple of boxes; the bundle is first cut in two, and the matches are rapidly put into the boxes and passed on to the packing department, to be made up into parcels of one dozen. These parcels are packed in cases made to contain the required quantities of boxes of matches.

THE SAFETY MATCH.—The great reputation which this Firm enjoys is chiefly due to the introduction of the celebrated Safety Match, which was patented by Mr. Bryant, who had the monopoly of the manufacture of this specialty until the patent expired. So important an invention could not fail to meet with the speedy recognition of the public. Who has forgotten the suffocating sulphur match, which made the act of lighting gas or candles a positive torture? The substitution of other and inoffensive compounds for sulphur was an innovation and a boon to the public, but that improvement was quite eclipsed by the invention of the safety match. Many of us can recollect the accounts which frequently appeared in the newspapers of children who were burned to death through playing with lucifer matches. As the match was a necessity of civilisation, and produced at a price within the reach of the poorest of mankind, it is not surprising that mischievous children possessed themselves of the match-boxes whenever they had an opportunity of gratifying their curiosity. The matches were frequently left in accessible places, and the Coroner's Courts bore testimony to the dangers attending the unrestrained distribution of lucifer matches. Bryant & May's Patent Safety Match effected a complete revolution in the trade. They produced a match which could not by any possible means be lighted by rubbing it over sandpaper or any other roughened surface; only upon the sides of its own box could the match be ignited. Fires have been caused by accidentally treading upon the ordinary match. No amount of stamping will light a safety match. To prevent accidents to children who are intelligent enough to know that the matches must be rubbed upon the sides of the box in order to produce fire, it is only necessary to keep the matches in one place and the boxes in another. The patent safety match was for some time the subject of controversy amongst the curious and scientific men, but it did all that the inventor claimed for it, and careful parents, and those having the care of large premises and valuable collections of treasures, soon adopted it, and refused to allow the use of any other kind of match.

At the present time Bryant & May's safety matches may be purchased retail at about sevenpence-halfpenny per dozen boxes. They are also made up in various kinds of fancy boxes, with a reserve stock of prepared paper, so that these superior boxes can be refilled from time to time from the ordinary wooden boxes. It would be difficult to find a spot on the earth inhabited by a civilised race where Bryant & May's safety match is unknown.

The manufacture of Wax Vestas at Fairfield Works is an important branch of the business. The cotton yarn is wound upon drums and passed through a bath of melted stearine, &c. The taper, after being waxed, is wound upon a huge cylindrical frame. Each length of taper measures 3,000 yards. One cylinder we saw at the time of our visit contained 300,000 yards of taper, or 100 lengths of 3,000 yards each. The wax taper is cut by a very pretty and valuable machine into the requisite lengths. The match bodies so cut off are transferred to frames constructed of the required depth. They are then dipped into the igniting compound, and treated in exactly the same way as ordinary matches. After the dipping process they are dried, sorted, and packed in boxes of various sizes, patterns, and capacity. While we were inspecting the making of wax vestas, we noticed a number of girls filling small round fancy boxes, unlike anything we had seen in the shops of this country. One of the Directors of the Company informed us that these boxes were for shipment to the Fiji Islands. The Polynesian has cast aside his rude fire-drill for Bryant & May's wax matches—a sure sign of his adoption of the customs of civilised races. Possibly the Fijian of to-day would as soon think of using the primitive fire-drill as of making a meal of a neighbouring islander.

In another department the "Vesuvians," used as lights by smokers, are prepared. These matches have rounded splints made of hard wood, the object being to prevent the ignition of the wood and consequent dropping of the burning composition. Messrs. Bryant & May have an ingenious method of manufacturing their well-known Braided Lights, retaining the composition by means of pieces of thin wire placed on each side of the splint; the wire is kept in position by means of cotton, which is put on by the braiding machine. The vesuvian-splints are dipped several times into the burning composition until the head is of sufficient size, and then finally dipped into the igniting compound in the same way as an ordinary match, an interval being allowed between the operations for drying.

Before dismissing the subject of cigar and pipe-lighters, we must not fail to notice an excellent "vesuvian," made with a wax-taper splint instead of braided wood. These are called flaming wax vestas, and give a splendid flame, which lasts long enough to light tobacco in boisterous weather, and, when the flaming compound has burned out, the taper part continues burning like an ordinary wax vesta. The flaming vestas are made up in artistic metal boxes, and sold by retail vendors for the modest sum of one penny.

The cases used for packing the matches for the export trade are made up by Messrs. Bryant & May. In one enormous store-room we saw thousands of cases all ready for shipment, each case containing several grosses of boxes of matches. There are other store-rooms at Fairfield Works, filled with thousands of reams of paper and great quantities of printed labels, &c.

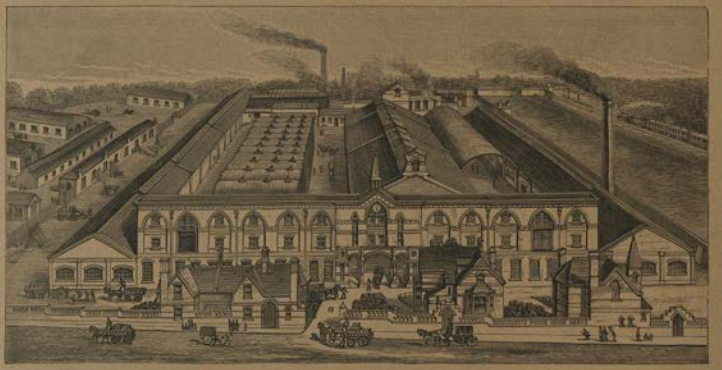
At the saw-mills and box-factory they make the boxes for the matches. We were shown here several other wonderful machines, many processes in the various manufactures conducted at this branch being performed by a single machine in an astonishingly short space of time.

Of course, it will be understood that it is only by means of the improved labour-saving machinery which Messrs. Bryant & May have introduced of late years that matches can be sold at such astonishingly low prices. It is a mistake to suppose that their machinery robs the poor of the fruits of hand-labour, and throws them out of employment. Statistics prove that the more that machinery is adopted by manufacturers the more work there is for the labouring classes. This may seem a paradox, but it is, nevertheless, a positive fact. When railways were suggested people were horrified, and the "know-alls" prophesied that horses would be a drug in the market. When the London Underground Railway was projected, it was believed by many persons that omnibuses would, soon after the opening of the line, be running to and fro to carry a few timid old ladies who feared to trust themselves in the tunnel under the roadway. There were never more omnibuses and cabs than there are at the present time, and, in spite of the network of railways in this country, horses are as dear and as much in demand as they ever were. Messrs. Bryant & May have a most extensive plant, comprising some beautiful machines, each of which does the work of a large number of hands, but they never had more operatives than they employ to-day.

In addition to the extensive manufacture of matches, wax vestas, and vesuvians, Bryant & May do a large business in those pretty tea-canisters, biscuit-tins, and fancy tin boxes of all kinds which one cannot help noticing in every grocer's window; these are constructed at Reading, many of them out of one piece of metal. The patterns are most artistic, indeed, they are almost too good for such low-priced articles. If the canisters and boxes were scarce and high-priced they would be valued more than they are. English people, unfortunately, seldom judge a thing from an artistic standpoint. The first question usually asked is, "How much did it cost?" and, if the article is perfectly useless, and ugly into the bargain, it is highly valued if it cost a good round

sum. Many of the designs printed upon the tin boxes by Messrs. Bryant & May's patent process are copied from rare works of art, and thus the poorest individual can adorn his cottage with articles which would, in the days of our grandfathers, have been deemed worthy of a place on the sideboards of the well-to-do.

In 1884 Messrs. Bryant & May's extensive business was formed into a Limited Liability Company. The shares were eagerly taken up, as may be imagined. After nearly half a century's work the place had grown into a big factory, and the reputation of the Firm was established. The shareholders have reason to congratulate themselves upon their investments, for, at the last general meeting, held at the Cannon Street Hotel, a dividend at the rate of 22½ per cent. per annum was declared! The Board of Directors at present includes Mr. Wilberforce Bryant (chairman), Mr. Frederick Carkeet Bryant, Mr. Otto H. Trummer, Mr. Edmund John Pace,



MESSRS. BRYANT AND MAY'S FAIRFIELD WORKS, BOW.

and Mr. E. M. Dixon, late of Dixon, Son, & Evans, match manufacturers, Manchester. The secretary is Mr. William Carkeet, and the manager of the Offices Mr. Gilbert Bartholomew.

The management of the Fairfield Works is under the direction of Mr. Dixon, and that of the Saw-mills and Box Factory under the superintendence of Mr. Pace.

The view will give the reader an idea of a portion of the Fairfield Works at Bow, but the whole of the shops and stores are not shown in the drawing.

In this country Messrs. Bryant & May have no rival, and it is a question whether there is another match factory in the world so admirably conducted, and so well known by all classes of society, as that of this highly-esteemed and old-established Firm.

The Liverpool Patent Lint Company, Liverpool.

THERE are no beneficent institutions in the country which appeal more strongly to the tender side of human nature than our hospitals and infirmaries. According to our means, we may rely upon private medical aid to bear us through those grave crises of illness which come alike to the weak and to the strong at some periods of life; but, in the misfortune of sudden accident to the body, it is to the nearest hospital that we are borne. A department of industry, therefore, which contributes in any way to the succour of the victims of accident or disease, is certain to command a large share of sympathetic attention. In this view we have selected for notice the factory of the Liverpool Patent Lint Company, situated at Everton, in the northern district of the city by the Mersey. The business, which is of modern growth, fulfils a distinctive mission of its own, and has before it, in the future, an ever-widening domain of usefulness.

The making of lint and bandages by machinery was an event of which Abernethy or Astley Cooper could have little dreamed, and the prejudice of the medical profession — than which there is no body more cautious or conservative—against an innovation of the kind, is not yet entirely overcome. But the process of enlightenment and salutary change in this, as in every other department of human progress, if gradual, is also sure. Considerably less than fifty years ago, the surgeon's lint was made of old linen, in a manner tedious and uncertain. The hospital nurse would, with a knife, scrape one side of the linen, and raise thereon the soft fluff or down intended for immediate contact with the wound. In proportion to the time and care required, the result was but meagre in the quantity of lint made; and an irregularity of surface, which was more or less unavoidable, dependent upon the degree of skill exercised, always existed. By the application of machinery to lint-making the clumsiness of this plan has been rendered obsolete, and an article can be produced which is superior in all respects and perfectly adapted to surgical needs. Lint of this description can now be obtained so cheap that it is surprising it is not more largely in demand for wound dressings. The Liverpool Patent Lint Company weave all their own lint-cloths from yarns of good quality, spun for this special work. The weaving of the lint, and the raising of its "pile," or surface, are accomplished by one continuous process, and great care has to be exercised in the setting of the machines for this purpose, so as to produce a material, combining the essential qualities of softness and uniformity. A fault of lint made in the old way was its uneven and irregular surface, from the fact of the linen having been scraped more in some parts than in others; a second serious defect was that it would not tear readily, as required in the surgeon's hands. The varieties of lint, both of flax and cotton, made in the Liverpool factory, tear easily in any direction; and another noteworthy feature is the care taken to exclude from their manufacture all chemical and other impurities. On these accounts they are steadily-growing in the appreciation of the medical profession, and are coming into extensive use in public hospitals and infirmaries.

In building up the business as it exists at the present time, one of the chief difficulties of the proprietors was to find operatives competent to carry their methods of manufacture into execution, and in the beginning they had almost personally to train the staff of females it was necessary to employ. The business is conducted by two energetic partners, one of whom applies himself more particularly to the details of administration and economical working, bringing to bear upon them sound sense and clear judgment. The other, having considerable experience in engineering, gives his attention to improvements of machinery; and, acting in accord, both have always been on the alert to enlarge their existing facilities, and utilise novel ideas which have occurred to them in relation to improvements of plant or materials.

The Liverpool Patent Lint Company are makers of surgical bandages also, in several varieties, both white and grey, the cloths for which are woven on the premises by other machines. The special features of these cloths are their absolute purity, combined with softness and coolness. So rapid and efficient is the machinery employed, that, in the case of these bandages, they are supplied to medical institutions at a price fully one-third

lower than the cost of the inferior article formerly bought, and with the additional advantage of being parcelled up into rolls of any required length ready for instant use. The Company also prepare and supply absorbent wadding and absorbent cotton-wools for medical and surgical purposes, as well as jute and flax tow, which they carbolise at their factory. Of the principal weaving-shed, which is about 150 feet long, we furnish an interior view. This shed contains upwards of one hundred machines of various kinds.

The business of which a brief review has been given, represents a branch of British industry that was all but unknown fifteen or twenty years ago, and its development, under many obstacles and discouragements, redounds to the credit of its present management. The Company, at the date of this article, are erecting additional premises, one section of which will be entirely devoted to bleaching. The manufacture of other articles needed by the physician and the surgeon will also be undertaken.

The antiseptic and sanatory properties of the Liverpool lints and bandages have been acknowledged in the receipt by the Company of orders from the British Government, from various foreign Governments, and from national hospitals and other leading medical institutions throughout the world.

Messrs. Cantrell & Cochrane, Dublin and Belfast.

HOWEVER unfortunate may be the general condition of Ireland, and however backward some of her industries, there are others again in which the Sister Isle is able to compete successfully with all rivals, and, holding a prominent place among such industries is the manufacture of mineral waters. The production of these delicious and wholesome drinks, already enormous, is nevertheless increasing yearly; and Irish mineral waters are well known and appreciated in every corner of the civilised world. As the leading Firm in this branch of manufacture, Messrs. Cantrell & Cochrane, whose Works are situated at Dublin and Belfast, fittingly find a place among the representatives of the Arts and Industries of the United Kingdom. The reputation of this noted Firm is of world-wide extent; and it may justly be claimed that they have been largely instrumental in developing an industry which has contributed in no small degree to the commercial prosperity of two of the most populous and important cities in the British Isles.

But commercial considerations apart, it will be seen from a totally different point of view, also, that Messrs. Cantrell & Cochrane are deserving of the gratitude and good wishes of their countrymen. As is well known by every temperance advocate, one of the greatest difficulties which the cause of temperance has had to contend with has been the scarcity and unattractiveness of non-intoxicating drinks; and any one, therefore, who helps to place within reach of the public a really palatable substitute for beer and wine and spirits is doing more probably in the cause of temperance than half-a-dozen temperance lecturers. There may be differences of opinion concerning the justice and wisdom of interfering with the liquor traffic by legislation; but none, concerning the propriety and beneficence of tempting the public to abandon alcoholic liquors by setting before them wholesome and agreeable beverages of a non-alcoholic nature. This is precisely the part, and a very important one, in the temperance movement which has been taken by the celebrated Firm we are discussing, all of whose products are entirely non-intoxicating.

The foundation of the enormous business which this Firm conduct was laid in 1852 by Dr. Cantrell, who in that year commenced operations in Belfast. His original premises were situated in Bank Lane; but in spite of frequent extensions, these were soon found to be insufficient for the growing business, and a move became absolutely necessary. Thereupon Dr. Cantrell migrated to the magnificent premises in Victoria Square, known as Cromac Buildings, where the Belfast branch of the business has ever since been conducted. In 1868 a partnership was arranged between the original founder of the concern and Alderman Cochrane, of Dublin; and while the Belfast branch continued to thrive and grow, perhaps even greater progress was made at the Nassau Works in the Irish metropolis, the fame of the Firm rapidly spreading to all quarters of the globe. Two or three years ago, the founder of the enterprise retired, and Alderman Cochrane, who, besides occupying a seat in the Corporation of Dublin city, is a Deputy-Lieutenant, and also holds a Commission of the Peace for Dublin county, has since that date been the head of the Firm.

If we were asked to assign the cause which has led to the extraordinary success attained by Messrs. Cantrell & Cochrane, we should probably give as the primary one the spirit of enterprise and the indomitable perseverance displayed by the members of the Firm, with which must be coupled their constant endeavours to do a large business in a way that shall give complete satisfaction to the public. As a secondary cause, resulting in a great measure from the first, we should have to mention in particular the scrupulous cleanliness with which the operations are conducted throughout their Works, a point which is clearly of the very first importance in the manufacture of such goods as mineral waters. But having made reference to these two causes we should have to lay special stress on a third, which to a certain extent is independent of the qualifications of the members of the Firm themselves, namely, the abundant supply of the purest and most suitable water, which they have at command both in Dublin and in Belfast. We say, to a certain extent only, this cause is independent of the qualities possessed by Messrs. Cantrell & Cochrane, since, although the Firm were not the creators of the springs, the enterprise they displayed was absolutely necessary, or the springs could never have been utilised by them. To take the water supply at the Belfast Works first. Before the manufacture could be commenced in Victoria Square, a sum of no less than £2,000 in hard cash had to be laid out in sinking a well, and this, be it borne in mind, without any certainty that every penny might not be entirely lost. For the first thirty-eight feet from the surface of the earth, layers of silt and blue lias were passed through, after which came peat and various gases; lower down still came in order gravel, clay, rock, sand, gravel, and finally a stratum of red freestone, with which was obtained, to the great relief of the proprietors, the abundant supply of sparkling Cromac water, so peculiarly adapted for their purpose. It was not, however, until a depth of 116 feet was reached that this fortunate result was obtained at the above-mentioned cost.

In Dublin the Firm procure the water for their Works from the famous St. Patrick's Well. Thirty years ago, St. Patrick's Well was known only to the antiquary, and to him merely by report, although in olden times it had been held in great reverence by the disciples of Ireland's patron saint. The perseverance and research, however, of Alderman Cochrane brought the spring again to light; and its pure and sparkling waters are now turned to account by Messrs. Cantrell & Cochrane, in their manufacture.

In the same way that the water of Burton-on-Trent has done so much for the brewers of that town, have the Cromac Springs of Belfast, and St. Patrick's Well in Dublin, aided Messrs. Cantrell & Cochrane in establishing a world-wide reputation. Upon the suitability of the water supply, perhaps more than on anything else, depends the success or failure of attempts to produce an aerated beverage that shall prove acceptable to the public; and it is doubtless owing to the peculiar suitability of Belfast water for the purpose, that the branch of manufacture under notice has been so highly successful in that city.

With a view to give some idea of the scale on which operations are conducted, we may mention that the Firm employ over five hundred men, and that no less than fifty two-horse vans are kept to deliver their goods to the wholesale dealers. The Works have capacity for turning out the extraordinary number of 160,000 bottles a day, when the state of trade requires it. Organisation and methodical arrangement are everywhere resorted to for the purpose of carrying on the extensive operations of the business at once smoothly and without waste of any description. The Dublin premises, situated in Nassau Place, at the rear of Kildare Street, cover an area of nearly half an acre, and the Belfast Works, which are the most extensive in that city, are about equally large. To facilitate the conveyance of bottles from one part of the Works to another, tramways have been laid down in all directions.

In the Dublin Works are two gas-generators, the largest in Ireland, and two powerful steam-engines. All the machinery is constructed on the most modern and highly-approved principles, and no expense has been spared in fitting it up. The patent travelling lift, designed by Alderman Cochrane himself, is particularly interesting; it performs an important part in the saving of time and labour. Upwards of twelve machines are employed in bottling, of which four are constructed on an improved principle and patented, and work with such rapidity that they are capable of turning out between them 60,000 bottles a day. One of these machines alone will turn out 2,000 filled bottles in an hour, and keeps five men busily engaged in tying. The cleansing department in a mineral water factory is by no means an unimportant one. Here, before being filled, the bottles are first placed in hot water, then vigorously brushed both inside and outside, and finally rinsed with care in pure cold water. From this department they are taken to the bottling-room, down the centre of which are ranged the bottling-machines. An operator sits in front of every machine, and as each bottle reaches his hand he places it beneath the mouth of the feeding-tube; inserting the cork, he drives it nearly home by the pressure of a descending rod, and the required quantity of syrup is then forced in.

Next, the atmospheric air is exhausted, the bottle is quite filled up, and the cork driven home; after which the operation of bottling is completed by a boy, who wires down the cork. This, however, is only one, although the ordinary, method of procedure; elsewhere in the Works may be seen the process of bottling on the improved principle with the automatic rotary machines. Each of these is fed by one man with both corks and bottles, the air being exhausted from the latter as the apparatus revolves. The filling and corking then follow with the most marvellous rapidity, and the bottles on leaving the machines are wired by boys, as in the ordinary process. By the old method one operator can bottle about twenty dozen an hour; by the new he can bottle six times that number. Nothing but such materials as gutta-percha, glass, and silver are used in connexion with the bottling-machines, lest any risk should be incurred of metallic contamination; and we may here remark that a similar precaution is taken in the syrup department, where the vessels are made of glass, porcelain, or some such material.

ALDERMAN HENRY COCHRANE, D.L.P.
Chairman of the Citizens' Jubilee Committee.

The operation of packing for export deserves a word in passing. The bottles to be shipped abroad are carefully filled, corked, and wired, and finally packed with care in barrels, the risk of breakage being obviated by means of the hay and straw with which they are surrounded. By the adoption of this system the goods of the Firm can be sent in safety to any part of the world.

Although an abundant supply of the very best water is the first requisite for the successful manufacture of effervescent beverages, each variety of aerated water, of course, requires also its own special ingredients, which, too, must be of the very best quality. The gas, which imparts the property of effervescence to the various drinks, after being thoroughly purified, is stored in gasometers, to be drawn off as required. A pressure of about 150 lb. to the square inch is employed for the impregnation of the water with the gas. The department in which the different syrups are prepared, that give to each beverage its own distinctive flavour, is located above the bottling-room, and, if any portion of the Works is characterised by the most scrupulous cleanliness, that is the case, above all, with this department. For the manufacture of their famous Aromatic Ginger-Ale, Messrs. Cantrell & Cochrane spare no expense. This delicious beverage has been spoken of

in terms of the highest praise by the press and by the medical profession, and, as a warming and invigorating yet non-intoxicating drink, agreeable to the palate and thoroughly wholesome, is, perhaps, without a rival. Messrs. Cantrell & Cochrane have bestowed the greatest care and attention on the perfecting of it; and their reputation is, perhaps, more intimately associated with this than with any other of their products. The delightful aromatic property and unrivalled purity of the ginger-ale, combined with its widespread popularity, have procured for it the appellation of "the beverage of the world." It has qualities which render it peculiarly suited to take the place of alcoholic drinks: in the first place, it is not in the least injured, but, on the contrary, improves with decanting; and, in the second place, it is adapted for any climate, whether the hottest or the coldest, and its use may, therefore, become general throughout the world.

Another of the aerated waters produced by Messrs. Cantrell & Cochrane, which has attracted the notice of the faculty, is their sparkling Montserrat, made from the celebrated lime-fruit of the island which bears that name. Not being content merely to move on the old lines, and produce only the drinks which they found in existence, the enterprising Firm boldly took upon themselves the task of devising a new hygienic and non-intoxicating beverage, and the result has been most gratifying. Every one is acquainted with the agreeable flavour and hygienic value of the juice of the lime-fruit; and, working upon this as a base, Messrs. Cantrell & Cochrane have concocted a delicious beverage, which, in the opinion of many a good judge, is the most formidable rival of alcoholic drinks that has ever yet been put forward. Already it has become renowned far and wide, and has been rewarded with the highest honours, not only at home but in distant lands as well, as a cooling, refreshing, exhilarating drink; it has everywhere met with a hearty reception, and by the medical profession it is recommended, particularly in cases of rheumatism and gout.

The "Club Soda" manufactured by Messrs. Cantrell & Cochrane is warmly approved by the distinguished chemist Sir Charles Cameron, who goes so far as to declare it the most wholesome daily beverage that can be taken. It is strongly recommended as an antidote to acid dyspepsia and a promoter of digestion, and has even received the special appellation of "The Beverage of Health." In the Seltzer waters which the Firm manufacture, and for which they have become famous, the mildly alkaline and tonic properties present in the water from the Seltzer spring are reproduced; and in their sarsaparilla, the blood-purifying properties which the plant of that name possesses are retained. Concerning this last-named beverage, considering its fine aroma and flavour, we cannot help remarking that more attention should be paid to it by the public than has hitherto been the case. The lemonade manufactured by the Firm is a most delicious drink, from which the flavour of the lemon is not banished as it is from some lemonade. The potass water and lithia water, both of them refreshing and agreeable drinks, retain respectively the medicinal properties of the ingredients from which they take their titles. Of the aerated quinine, aerated tonic bitters, and Carrara waters, our space will permit us to do no more than give the bare names.

We must not omit specially to mention as last, but by no means least, of the beverages for which the public are indebted to this Firm, that in order to commemorate and mark as an epoch in their career the occurrence of Her Most Gracious Majesty's Jubilee, Messrs. Cantrell & Cochrane have just brought out an entirely new beverage, to which they have given the name of "Koh-i-nur." Space will not permit more than a passing reference to this beverage, but in a word it is as brilliant and as sparkling as the jewel whose name it bears, and bids fair to perpetuate our Jubilee Year, by means of a wholesome and delightful beverage, to generations yet unborn.

Messrs. Cantrell & Cochrane's goods, while obtaining an enormous sale at home, find their way also to the most remote parts of the earth. The following are among the colonies and foreign countries to which they are exported:—Malta, Russia, India, New Zealand, Canada, the West Indies, Cape Colony, South America, Australia, and the United States. In a single week the Firm have shipped as many as 20,000 dozen bottles to the last-mentioned market alone. They hold a special appointment as manufacturers to the Lord-Lieutenant of Ireland, and are also purveyors to the Houses of Parliament. They were contractors for the Abyssinian expedition, and are now contracting for the following lines of steamers:—The Cunard, the Inman, the Montreal, the Oceanic, the National, the Pacific, and the Anchor.

Messrs. John Davis & Son, Derby.

IT would be difficult to conceive any industry which could claim a greater degree of intellectual labour than the designing and manufacturing of apparatus used in mining, surveying, and engineering operations. It is our privilege to give our readers a short history and description of the Firm which has undoubtedly earned through a period extending over half a century the highest reputation in this interesting and useful department. The house of John Davis & Son, of All Saints' Works, Derby; 118, Newgate Street, London; and Bute Crescent, Cardiff, was established in the year 1828 by John Davis, at Derby, a man of very considerable scientific attainments, a manufacturer of philosophical apparatus. For many years the chief employment of this Firm was in such appliances as were required in the laboratory for the study of electricity, pneumatics, &c., but the gradual opening and rapid and enormous development of coal and iron and other mineral resources during the last fifty years, the construction of railroads, and the collateral survey of lands at home and in the Colonies created a demand for various appliances and instruments of precision.

Engineers were not slow to recognise the ability of the founder of this Firm, an able constructor of their requisites. The changed times produced inventors, and those of the first order flocked to John Davis to have their creations matured, perfected, and manufactured by the band of skilled craftsmen attached to him. Amongst the numerous appliances invented or manufactured by John Davis & Son were several, the utility and necessity for which in coal-mining for purposes of safety were so imperative, that their employment was made compulsory by an Act of Parliament known as the "Coal Mines' Regulation Act," 1872.

With the continued development of railroads, coal-mining, and engineering generally, the requirements for apparatus to survey land, mining dials for indicating the amount of coal extracted, and the exact position of the underground working, electric blasting apparatus for sinking shafts, getting coal and removing rocks, anemometers for testing the ventilation of collieries, miners' safety lamps, electric signals for pit shafts and engine planes, and numerous other machines, grew apace; and this Firm being equal to the occasion was not long in taking their place as the leading manufacturers of complete equipments of scientific apparatus for mining, surveying, and engineering operations. We will now proceed to pass under review a series of valuable instruments manufactured by Messrs. Davis, used in mining operations.

MINERS' DIALS.—The Hedley Dial, which takes its name from the late Mr. John Hedley, H.M. Inspector of Mines for the Midland district, was introduced by Messrs. Davis about the year 1855, and its present form, as shown by the illustration, is the most modern and approved design of miners' dial for the varied conditions of underground surveying. The original construction has not been seriously altered, but from time to time many improvements have been made to render surveying with it so accurate that the work executed may be equal to that of a theodolite. The dials of this Firm are adopted in all the coal-getting countries of the world.

Amongst the most recent improvements in Davis's improved Hedley Dial, the following may be mentioned:—By a special arrangement of the plates a vernier placed on the outside circumference reads simultaneously with the needle. This in itself is of great advantage; but other objects are also obtained, viz., the vernier may be more easily read, as the necessity of raising the head above the dial face is obviated. The concentricity of the dial plates may be ascertained by setting the needle and vernier to 360°, and then revolving the plates by means of the vernier screw, and reading off, say the four quarters. The old form of quadrant arc has been entirely reconstructed—the new arc is a fixture, and consists of a circular box 1¾ in. diameter, with a hand traversing a dial plate divided into 90°. For very elaborate surveys a powerful telescope is supplied in addition to and interchangeable with the sights. This enables the surveyor to take longer and more accurate sights. To be of any real service and value, accuracy is the first and most essential condition of all underground surveys, and to this end the provision of good and suitable instruments is most desirable, and in the end most economical.

Messrs. Davis may be congratulated for their perspicuity in taking up an American invention of great value as an adjunct to theodolites, dials, and levels, viz., the Hoffman Patent Tripod Head.

SURVEYING AND LEVELLING INSTRUMENTS.—The Hoffman patent tripod head, for instantaneously setting and levelling up field instruments, claims to have brought surveying appliances to a point more nearly approaching perfection than has been heretofore attained. The ordinary form of tripod has now been in use for about

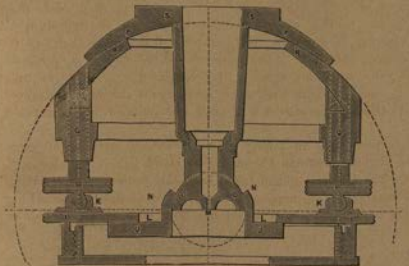
DAVIS'S IMPROVED HEDLEY DIAL.

DAVIS'S IMPROVED JOINT FOR DIALS. HOFFMAN'S PATENT, NO. 2,084. HALF-SIZE.

forty years, and has done good service; but the work of levelling up by means of parallel plate screws is tedious and troublesome, and the old instrument which it superseded was positively superior in speed of adjustments. The new tripod is an improvement on the ball-and-socket motion, the object being to impart accuracy to what has been heretofore treated as a rough-and-ready arrangement. It is computed that by the use of the ordinary parallel plates no less than two-thirds of the surveyor's time is taken up in making adjustments, and while he is doing so his assistants are perforce idle. All this time is saved by the use of the new head, the principle of which may be briefly explained. The instrument is approximately levelled in an instant by the ball-and-socket arrangement, and it can then be brought to strict accuracy by a half turn of one or two of the adjusting screws, which at the same time clamp the patent joint: the handiness of the ball and socket, and the accuracy of the screw adjustment, are thus attained. None but professional surveyors will care for a more precise description of the improvements, and we must refer them to the manufacturers for further information. In England these instruments are chiefly used in levelling and laying out roads and railways; but in the colonies and other new settlements the Surveyor-General is an important functionary, and he has a numerous staff of trained surveyors, whose principal work consists in an accurate sub-division of the Crown lands. The importance of having reliable instruments of easy adjustment is there fully realised, and the laying out of new roads through scrub and bush requires a great deal more judgment than is sufficient for the levelling of old roads: these instruments are therefore in extensive demand in the remoter parts of the empire.

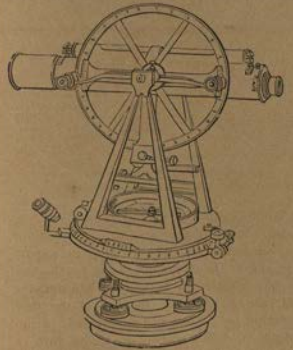
The Gravatt, or Dumpy Level, plays an important part in laying out railroads, tunnelling, and irrigation; and this instrument has been brought to great perfection by Messrs. Davis, who combine the Hoffman Patent

Tripod Head with the best telescope. Before leaving the department of levelling instruments, we will notice a very compact Clinometer for prospectors. It is constructed of gun-metal of very light design. The accompanying illustration will convey to the surveyor its general construction. The Clinometer is provided with a light tripod and ball-and-socket joint.



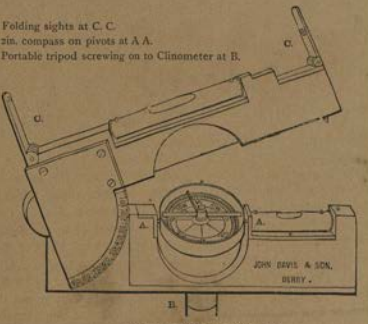
HOFFMAN'S PATENT JOINT FOR DIALS, LEVELS, AND THEODOLITES, TAKING THE PLACE OF THE PARALLEL PLATES, AND THE BALL-AND-SOCKET JOINT.

DUMPY LEVEL.



TRANSIT THEODOLITE, WITH THE HOFFMAN PATENT JOINT AND CENTERING MOVEMENT.

Folding sights at C. C.
2in. compass on pivots at A A.
Portable tripod screwing on to Clinometer at B.



DAVIS'S IMPROVED CLINOMETER.

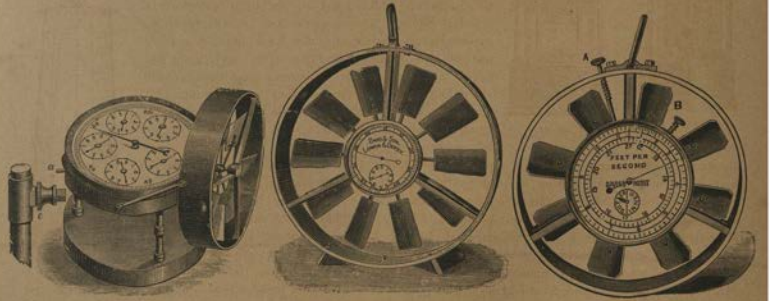
JEE'S PIT-LEVELLING STAFF.—In underground levelling engineers have always experienced the difficulty and inconvenience of using the ordinary form of levelling staff, and it has been with the object of remedying and removing such difficulties that the inventor, Mr. Jee, has been led to contrive a more convenient form of levelling staff for that purpose. The levelling staff is of three lengths, sliding into each other, and nearly resembles the ordinary Sopwith Staff in that respect. The bottom length is graduated upwards in the ordinary way. At the top of the first division of the levelling staff a band is attached, about two inches wide, which is graduated upwards, and forms an accurate continuation of the scale on the lower division of the staff. The band passes over a brass roller attached to the top or innermost division of the staff, and is thence

carried round a brass drum (on which it is wound) fixed just below the roller, to the top of the same staff, the band being kept in tension by means of a box-spring attached on one side to the axis of the cylinder. It will be seen from the above arrangement that when the second division of the staff is drawn out, the band unwinds, and gives a continuous reading *for any intermediate distance that the height of the roof will allow*, the band being kept in tension at the required elevation, and lying flat against the face of the second division of the staff. In the same way, when the third division is drawn out, a continuous reading may be obtained.

SIDE VIEW. FRONT VIEW.

DAVIS'S MINING AND SURVEYING ANEROID BAROMETER, READING TO ONE FOOT.—This instrument is specially for the use of mining engineers and surveyors, for the purpose of readily ascertaining slight variations in gradients, levels, &c., and, from its extreme sensitiveness, will be found of considerable utility in mining and surveying work generally. Besides its extreme sensitiveness, the specialty claimed for the instrument is an arrangement of the scale of altitudes which admits of sub-divisions by a vernier, hitherto impracticable, owing to the altitude scale in ordinary use being a gradually diminishing one, to which a vernier cannot be applied. In the present instrument the action has been so adjusted as to give accurate readings upon the regular scale of altitudes, the barometrical scale of inches being made progressive in length, so as to afford the correct relative readings with the scale of altitudes. For mining operations the entire circle of the dial is graduated to represent six inches of the mercurial column—that is, from 27 inches to 33 inches. This scale affords observations from about 2,000 feet below sea level to 4,000 feet above. The finest divisions of the altitude scale (1-100th) represent 10 feet measurement, which can be again divided by the vernier scale to single feet. The vernier scale is moved by rack-work adjustment, and a lens which rotates on the outer circumference of the

SURVEYING ANEROID.



BIRAM'S PATENT ANEMOMETERS. DAVIS'S PATENT SELF-TIMING ANEMOMETER.

instrument facilitates the reading of the minute quantities. For surface surveying purposes, where it is not required to be used below sea level, the instrument is made with the scale divided from 25 to 31 inches—thus giving an altitude scale of 6,000 feet above the sea level only; and with this open scale and the assistance

of the vernier, the same minute readings to single feet may easily be taken. The instrument is 4¼ inches in diameter, and is provided with a leather sling case—thus making it sufficiently portable for all practical purposes.

ANEMOMETERS.—After passing through the department devoted to the manufacture of Mathematical Drawing Instruments, we next come to a very important section, viz., the manufacture of instruments for recording the amount of air travelling through the different underground passages of a coal-mine. This apparatus is the invention of Mr. Benjamin Biram, who took out Letters Patent about forty years ago. The Biram Anemometer is adopted throughout the whole mining world. The principle of the instrument may be briefly described thus:—A set of vanes resembling a miniature windmill is set revolving by the current of air of which it is the duty of the anemometer to record. This movement is communicated by wheels and pinions to a series of hands travelling over graduated dials. A watch is employed to time the total number of feet of air which has passed per minute; the result multiplied by the area of the passage gives the total cubic feet of air per minute. Biram's Anemometer is also extensively employed for measuring the amount of air passing through furnaces, sewers, and in ventilating apparatus for buildings, &c.

An ingenious and very valuable anemometer has been invented and patented by Messrs. Davis, which dispenses with the use of a watch. By holding this instrument in the current of air to be measured for a few seconds it correctly self-registers feet per second. This anemometer, being only four inches in diameter, is quite as portable as the Biram, which it resembles in general outline, and is of equal utility, with the advantage of being self-timing and self-recording.

MINERS' SAFETY LAMPS.—The miners' safety lamps of to-day are very different from those manufactured a few years ago, although all the varieties are constructed upon the broad principle invented by Sir Humphrey Davy in about the year 1815. The simple Davy gauze lamp has, without doubt, done good service, and has stood the friend of vast armies of coal-getters as an efficient life protector in the past; and it is in consequence of the altered conditions of the coal-mines that this simple form of lamp has been proved wholly inadequate and unsafe, owing to their present high state of ventilation. In the mines of to-day the Davy lamp explodes, and the flame passes through the gauze and ignites the gas surrounding it. The well-known Stephenson (Geordy), and Clanny lamp have had their time of usefulness, and have in their turn given way to lamps which are safer, and which withstand all conditions which exist or are likely to exist in practical mining. The disastrous and too often-recurring explosions in our coal-mines have induced colliery owners and managers to thoroughly investigate the causes, and experimental apparatus have been erected to exhaustively test the various safety lamps. A Royal Commission was appointed to inquire into the causes of accidents in mines, and the possible means of preventing their occurrence, or limiting their disastrous consequences. The final report of the Royal Commission was presented in the year 1886, and in the section devoted to the subject of safety lamps it is interesting to find that three out of four lamps selected as the safest were already being manufactured by Messrs. Davis. These were the "Bonneted Clanny," the "Marsaut," and the "Bonneted Mueseler." An appliance was recommended by the Royal Commission for the extinction of all flame within the lamp should it become filled with explosive mixture. Messrs. Davis have patented and manufacture a double "shut-off" appliance, the invention of Mr. A. Stokes, H.M. Inspector of Mines. This "shut-off" is absolute in its action, and very easily manipulated.

BONNETED CLANNY. (Stokes's Shut-off.)

MUESELER.

MARSAUT.

LIGHTNING CONDUCTORS.—The manufacture and erection of lightning conductors is a subject to which Messrs. Davis have given thorough attention. Although France and some other countries have taken active steps to give official sanction to the best-known means of protection from the effects of lightning, nothing in this way had ever been done in England for the public generally until the Meteorological Society took action. A meeting of the council, held 15th May, 1878, resolved to invite delegates from other scientific societies to

co-operate in considering the desirability of issuing a code of rules for the erection of lightning conductors. All well-known Firms were invited to answer a series of questions as to the best form of lightning conductor and the best mode of erection. The replies in answer to this invitation made by Messrs. Davis are published in the report of the Lightning Rod Conference, and it is noteworthy that the general system which had been adopted for many years by this Firm anticipated and coincided with the plans recommended by the gentlemen composing the Conference.

Messrs. Davis publish an important statement, showing the necessity of periodically testing and repairing lightning conductors, which has been favourably commented on by several of the chief building and engineering journals. Messrs. Davis point out that it is a popular and dangerous mistake to suppose that a lightning conductor once fixed always remains efficacious, and requires no further attention. Not only is the conductor subject to corrosion, but it is liable in many other ways to get out of order, and may become worse than useless, and in itself an element of danger. The instrument known as the galvanometer, however, proves the condition of the conductor by passing a current of electricity through it to the earth, and, as the test is easy and inexpensive, it ought to be employed by all who are responsible for the safety of houses or public buildings that are supposed to be protected by lightning conductors.

Electric lighting has been included in Messrs. Davis's enterprises,—they lighted their Works with electricity in the year 1883, and have since carried out many important installations,—also electric blasting apparatus for use in mines (so strongly recommended by the "Accidents in Mines Commission"). The manufacture of telephones and building of lines receive a considerable amount of attention, and many of our most extensive collieries are fitted out with their electrical apparatus.

Before concluding we will notice an instrument for the control of watchmen, of interest to all employers of labour. The Patented Portable Watchman's Time Detector is, as its name indicates, a device for securing the most reliable control of night-policemen and patrols, as well as of watchmen in large establishments where it is requisite that constant vigilance should be maintained. The watchman carries the detector about with him, and at every point where his presence is wanted at stated intervals there is a key securely attached to the building or other structure. With this key he makes a mark, through an opening in the detector, and the position of the mark indicates the time which it was made. There are usually from six to twelve keys for each detector. It will thus be seen that for each station to be visited and controlled only one marking key is required, and that one watchman armed with one detector can record his presence at any number of stations that may be fixed upon, and that the number of rounds he makes will be accurately registered. These instruments appear to be well adapted for doing their work efficiently, and there should be no further occasion to ask the question—*Quis custodiat ipsos custodes?* according to its very free adaptation, "Who shall watch the watchman?"

WATCHMAN'S TIME DETECTOR.

The elaborately-illustrated catalogue of Messrs. Davis is a book of considerable interest to the engineer; it is interesting in its description of scientific apparatus, and is used in our leading technical schools as a text-book of instruments and apparatus used in the operations of mining, surveying, and engineering.

Messrs. Chappell & Co., London.

THE celebrated musical Firm of Messrs. Chappell & Co. began business in 1812, in New Bond Street, London, nearly opposite the handsome establishment so well known to the musical world. About seventy years ago, the Firm consisted of Mr. Samuel Chappell, Mr. John Baptist Cramer, and Mr. Francis Tatton Latour. After the lapse of seven years, Mr. John Baptist Cramer retired, and, as the exigencies of an increasing business necessitated greater accommodation, Messrs. Chappell & Co. removed to their present West-end house of business. Recent enlargements have increased the premises to three houses in Bond Street, and the site of a former stable-yard as well as of large back gardens of three houses in George Street, Hanover Square, London. During the first partnership the Philharmonic Concerts were established, all the business arrangements for which were made at the house where the first Firm commenced. Mr. Chappell very kindly lent his own house for the meetings of the Directors, whom he entertained. It is recorded that the celebrated Mr. J. B. Cramer "was then at the zenith of his fame, and the spirit would sometimes move him to play until two or three in the morning, to the great delight of his audience." The first partnership, as we have said, was identified with the establishment of the Philharmonic Society. The second term of partnership was brought to an end in 1826, when Mr. Latour withdrew, and carried on a separate business until 1839, which he sold to his former partner. In December, 1834, Mr. Samuel Chappell died, the business being carried on for the family.

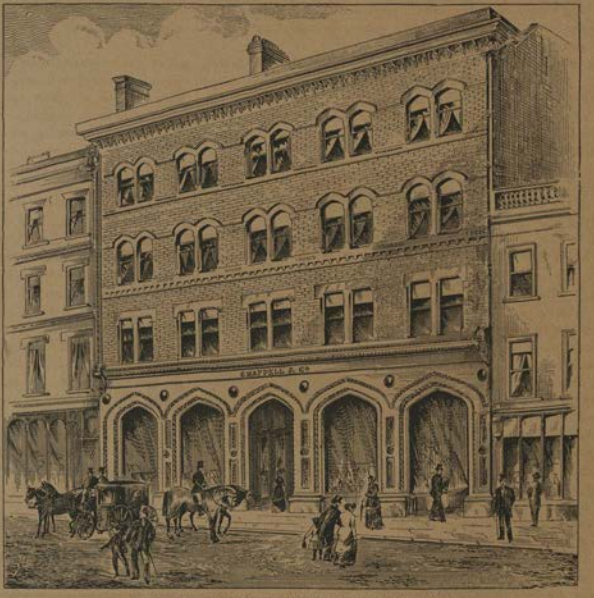
We learn that Mr. William Chappell, the eldest son of the deceased, being desirous of propagating a knowledge of the music of the Madrigalian era, projected the Musical Antiquarian Society in 1840, the meetings and rehearsals being held on the premises in New Bond Street. He (Mr. William Chappell) edited Dowling's songs for the Society, and he also edited and published in 1838-40 a "Collection of National English Airs," giving their pedigrees and the anecdotes connected with them, with an essay on minstrelsy in England. This was afterwards expanded into his "Popular Music of the Olden Time." Under the able and vigorous direction of Mr. Thomas Chappell the business was vastly extended, the name and fame of the Firm being now known almost as well in the Antipodes and distant foreign lands as they are in London; while the enlarged and splendid premises in New Bond Street will enable the visitor to recognise how admirably adapted they are for the purposes they were designed to serve. Mr. Thomas Chappell projected the Monday Popular Concerts and the Saturday Popular Concerts, the latter emanating from the primary enterprise. Both these undertakings have been rendered successful chiefly by the judicious management and untiring exertions of Mr. S. Arthur Chappell.

The St. James's Hall, Piccadilly, which is one of the institutions of the great metropolis, was projected, constructed, and established mainly by the Messrs. Chappell, who, being keen observers, saw that a grand concert-hall was wanted at the West End of London. If these gentlemen had done nothing else to cause their

name to be remembered, the founding of the St. James's Hall alone would afford sufficient evidence of their exertions to popularise music and foster a taste for harmony among the people.

The New Bond Street establishment of this Firm is a handsome, stately, and exceedingly commodious structure, the dimensions being about 240 feet from the entrance to the rear, and upwards of 100 feet in width or frontage. There are historic reminiscences which render the site particularly interesting.

The large Music Saloon is sixty feet wide, by about fifty feet in depth. This department is a music depôt and place of business, one part being set apart for office and counting-house purposes. At the rear is a grand staircase communicating with the upper portion of the house, which is devoted to the wholesale department



MESSRS. CHAPPELL AND CO.'S PREMISES, NEW BOND STREET.

of the music trade. All the fittings are of the most modern description, and every facility is afforded for conveniently carrying on the immense business of the Firm, the surroundings being marked by that degree of elegance and good taste that never fails to be appreciated. The public have in this establishment every possible opportunity afforded them to make selections of instruments and music, while the employés have ample space to carry out the manifold departmental duties devolving upon them. The entire establishment is as commodious as Government offices, and quite as handsome as many official departments. Beneath this fine saloon are extensive repositories, where the principal stock of music is kept in admirable order. The immense collection of music consists of some millions of copies, all of which are arranged so precisely that any specified composition can be referred to with promptitude by means of indexes. System and order in this division are

paramount, careful arrangement being absolutely essential, as the new publications number twenty in one week. The tens of thousands of copies of music are arranged on shelves contained in racks which run in rows, and to the uninitiated this apparently illimitable collection is like a maze, but certainly not "without a plan." Every piece of music is, directly after publication, forwarded by post to every large city in the world where the Firm have agents, thus facilitating the receipt of orders for new compositions in bulk. Directly facing the basement, and separated by a narrow passage, is a vaulted chamber, about sixty feet in length, excavated beneath the street, which contains the metal plates of the music published by Messrs. Chappell & Co. This fireproof chamber is fitted with Hobbs's patent doors and locks, which render it entirely secure. These precautions are necessary, the contents of the vaulted apartment being worth many thousands of pounds. From the front is presented to the view long ranges of instruments in perspective, and directly above the spot from which the spectator stands regarding the vista of pianofortes is a gallery protected by iron palisading, at the front of which is fixed a handsome pipe organ, most appropriately placed.

The sides which bound this gallery are fitted with many boxes, each of which contains music, labelled and numbered. From the central avenue, where many pianos stand, branch several spacious apartments, the grouped elliptic ceilings of which are remarkably elegant and graceful. The walls of some of these apartments are composed of wood, the blocks being fancifully arranged, presenting an appearance at once substantial and unique. The architecture has been devised with a view to secure those acoustic effects which are so requisite in an establishment where the quality and tone of instruments are almost constantly tested and keenly criticised by in- tending purchasers. On the walls of the Saloon hangs a por- trait of the Grand Mr. J. B. Cramer, the trait in oil of the late celebrated pianist, who was one of the original associates of the firm of Messrs. Chappell & Co. There are also large portraits of Mozart and Beethoven. Leading from this apartment is a saloon wherein are arranged longitudinally numerous pianofortes of a cheaper description. The adjoining room is devoted to those instru- ments made expressly for export, and to withstand the changes of climate,—all these pianofortes have iron frames, the strongest and most excellent woods being invariably used. Among other novelties is Chappell & Co.'s patent Æolian Pianoforte, invented by R. A. Kemp. As this instrument has all the appearance of an ordinary upright piano it is necessary to have it pointed out from among the great array of instruments in the Saloon. With or without the attachment, the tone is that of an ordinary pianoforte, the instrument not suffering in the least. By moving a foot-lever the organ is brought into play, and the tone is similar to that of a pianoforte and American organ played in duet, being delightfully soft and mellow. By the patented arrangement of the reeds in front of the sound-board and strings, an Æolian tone is obtained from the strings without the aid of the hammers: thus a chord sounded on the organ is reproduced on the strings, and is continued in combination with the organ as long as the keys are held down. At the will of the performer a tremolo may be obtained on a single note, a phrase, or during a whole piece, which resembles the *voix céleste* of an organ. By the use of a knee lever a crescendo and diminuendo can be made, and to produce the tone of an organ alone the player has only to place his foot on the soft pedal of the instrument, when the tone of the string is so far reduced as to allow of the organ tone being brought out prominently. In the same way it is possible to bring out melodies with sustained notes as clearly as on the organ. It is capable of producing slow music as well as the most lively and brilliant fantasias, and forms a pleasant accompaniment to the voice. Pianoforte players can in a very short time become perfect masters of the instrument,—the mode of actuating the organ by means of the small foot-pedal already referred to being of the simplest description. If desired, the organ action can be easily removed without the slightest detriment to the touch of the keys. The whole of the framework is in one solid casting—the wrest-pins drilled into the metal; extra screws in sound-board; felt on hammer pinned—so that the

MESSRS. CHAPPELL AND CO.'S MANUFACTORY, BELMONT STREET, N.W.

instrument is not easily put out of tune. It is suited to all climates, and being doubly overstrung the tone is very powerful and brilliant, while, as we have indicated, the touch is light and elastic. It is almost needless to mention that there are seven octaves, and that the new check action has been applied. The instruments are cased in rosewood, walnut, or ebonised wood, those for extreme climates being in solid walnut. The Æolian pianoforte, *considering the material, workmanship, and tone, is remarkably cheap, and will, no doubt, find its way into the drawing-rooms of those who are capable of judging of the merits and of placing a proper value on the instruments they use.* A great number of Messrs. Chappell's "Export" pianofortes are sent on board the yachts of the nobility and gentry; they also form part of the special equipment of oceanic steamers, which proceed to almost all quarters of the globe. Frequently the case of the instrument is made to match and form part of the ship's furniture, and occasionally the pianoforte case is specially designed to represent a bookcase, or any device in furniture the purchaser may select. An adjoining saloon is devoted to pianinos of every variety. These most compact and pretty instruments are both economical and effective; they help to adorn a home, and are within the reach of almost every person of moderate means.

In another room is a collection of instruments by various makers. In the centre of the Grand Saloon, and on the western side, is the entrance to the stores below, where there is also a gateway through which goods are received and despatched. The stores, containing packed instruments and packing-cases, extend over an area of about 24,000 square feet. That portion of the premises in which instruments are polished and repaired, situated in George Street, Hanover Square, was once part of the garden and the kitchen of the great William Pitt, Earl of Chatham, Prime Minister of England. This kitchen, with its tesselated pavement, now a busy workshop, was, before being converted into a workshop, fitted with various stoves; and from the *cuisine* of the eminent politician of the past century some hundreds of feet of piping were removed, the kitchen having been elaborately furnished with appliances for cooking.

In the "Oak Room," which is reached by crossing the main avenue, is kept a considerable stock of the well-known Alexandre harmoniums and small organs. Within the past twenty years Messrs. Chappell & Co. have sold the enormous number of 50,000 of these once-popular instruments. The harmonium has, of late years, been superseded by the American organ, and a spacious room, fronting New Bond Street, contains many admirable specimens of Messrs. Clough & Warren's celebrated combination pipe and reed organs. Messrs. Chappell & Co. are the sole London agents for Clough & Warren, who are the proprietors of a very large organ factory in Detroit, U.S.A., where they turn out 5,000 of their exquisite organs annually. Many of the instruments in this department are remarkably handsome and valuable. The smaller organs are delightful instruments, combining the softness of a flute with that grandeur of swell which might be expected from a large organ, but which when obtained from so comparatively small an instrument is, to say the least, remarkable. The combination organs contain a series of tubes which influence the quality of sound, and make them closely resemble pipe organs. In addition to this merit they possess surprising qualities of endurance and they are very portable. Above the American organ department is another spacious room in which are many pianos, pianettes, music-stools of various designs of ornamentation, stands, and other accessories. At Messrs. Chappell's manufactory, which is situated in Belmont Street, Chalk Farm Road, London, where 250 artisans are employed, great care is bestowed upon instruments in order to render them sound, durable, and impervious to the deleterious effects frequently resulting from changes of climate. When His Royal Highness the Duke of Edinburgh commissioned H.M.S. *Galatea*, Messrs. Chappell & Co. made for the Prince one of their ordinary check-action pianofortes in solid oak. This excellent instrument was shipped on board the famous frigate when she was at Plymouth, and it remained on board the man-of-war during the whole period of the ship's commission, going twice round the world. It is scarcely necessary to remark that the pianoforte was almost constantly used; the instrument so well maintained its original good qualities that the Duke of Edinburgh had it removed to Eastwell Park, in Kent, where it is now a favourite. As a remarkable instance of the durable manner in which the Firm's pianofortes are built, we may state that an instrument constructed by Messrs. Chappell, with folding keyboard, was on board the yacht *Mirage* when she foundered, in 1872, in the Solent off Calshott Castle. The piano, which was of maple, remained submerged in the hull of the vessel for twenty-four hours, long enough to entirely ruin any instrument, and render repair and renovation impossible. The yacht was raised, and with it the pianoforte, the latter being forwarded to the Firm for examination. It was found that although the action work was destroyed, the veneer and frame work were intact. The pianoforte was first thoroughly dried and afterwards repaired so successfully that it is now, after the lapse of so many years, and despite the lengthy bath it had in salt water, in excellent condition, and stands well in tune. Other instances tending to demonstrate excellence of make might be, were it necessary, related. One of Messrs. Chappell's pianofortes was sent on board the celebrated yacht *Sunbeam*, and was used by Lady Brassey during the now famous "Voyage of the Sunbeam" round the world. The instrument,

which is still in the yacht, is in admirable condition. Notwithstanding the very large business in pianofortes, American organs, harmoniums, and other musical instruments, it is as music publishers that Messrs. Chappell & Co. take first rank in England. They are the sole publishers of the Gilbert and Sullivan Operas, Gounod's "Faust," Cellier and Stephenson's "Dorothy," "Olivette," "Rip van Winkle," and a host of other popular operas, and from their house are issued all the English songs of Signors Tosti, De Lara, &c. The general public can have no idea of the difficulties with which such eminent music publishers as Messrs. Chappell & Co. have to contend when they wish to place before the lovers of good music an entirely new work. When Gounod's "Faust" was first produced in Paris, Mr. Thomas Chappell, ever on the look out for novelties, paid a visit to the French capital on purpose to judge for himself the merits of Gounod's *chef-d'œuvre*. The critical entrepreneur was delighted with "Faust," and firmly believed that the grand work would be eagerly accepted by English operatic managers. Soon after his return to London, Mr. Thomas Chappell had an interview with the late Mr. Gye, of Covent Garden, to whom he expressed his conviction that "Faust" would be a glorious success if produced at Covent Garden with a good cast. Will it be credited by the enthusiastic admirers of Gounod that Mr. Gye held a contrary opinion, and Mr. Chappell, discouraged but not convinced, against his own judgment laid the score of "Faust" on his shelf, *where it remained for two years?* Determined that the English public should have a chance of listening to one of the finest operas of modern times, Mr. Chappell offered Mr. Mapleson, of Her Majesty's, the sum of £200 towards scenery and accessories, if he would produce "Faust" at his theatre. Fortunately for himself and his audiences Mr. Mapleson agreed to the terms. The result is now too well known to need repetition. Mr. Gye, after the verdict of the British public had been circulated far and wide, begged Mr. Chappell to let him have the score on any condition, and "Faust" was then produced at Covent Garden Theatre. The musical world is certainly indebted to Mr. Thomas Chappell for his determination, even at the risk of a pecuniary loss, to have Gounod's "Faust" produced on the English operatic stage.

Messrs. Chappell & Co. have a branch establishment in the Poultry, London, somewhat similar to that in New Bond Street, but not so extensive. They have been awarded several medals for their instruments shown at the most important Exhibitions of late years, including London, 1862; Dublin, 1865; Dunedin, 1865; Cape Town, 1877; Sydney, 1879; and London, 1885.

Messrs. Henry Milward & Sons, Redditch.

UPWARDS of a century-and-a-half ago, that is to say in the year 1730, was first established at Redditch the now celebrated Firm whose name appears above, and it has remained in the same family ever since. Since Mr. John Frederick Milward and Mr. Victor Milward, the present partners, succeeded to the Firm some thirty years back, immense progress has been made by the business, until at the present day between seven and eight hundred hands are employed in the Works, and 8,000,000 needles are finished every week. Until shortly before the commencement of the present reign, this branch of manufacture had been carried on entirely by hand, and the process was slow and expensive. To the Firm of Milward & Sons belongs in a great measure the credit of having cheapened these small but invaluable articles; much of the patent machinery in use at the Washford and Forge Mills, where the operations of the Firm are conducted, being their own invention. Nor have they, in reducing the cost of manufacture and lowering the price of needles, neglected the quality of their goods, as a glance at the list of distinctions won by the Firm will abundantly testify: no less than seventeen or eighteen medals have been awarded them for the superiority of their manufactures, including those of which they were the recipients at the Exhibitions of New York, 1853; Paris, 1855, 1867, 1875, and 1878; London, 1862; Lyons, 1872; Vienna, 1873; Philadelphia, 1876; Sydney, 1880; and Melbourne, 1881.

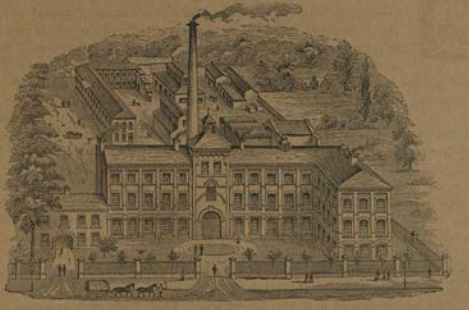
The art of needle-making was first introduced into England by one E. Kraus, a German, in the reign of Queen Elizabeth, previously to which time the bulk of the needles used in this country had been imported from Germany and Spain. Other needle-makers afterwards came from Normandy, and their trade was commenced at Long Crendon, whence it spread into various villages of Warwickshire, and eventually settled down on the borders of Worcestershire. Redditch, which was then but a small country village, has now grown into a manufacturing town of some importance, and by the survival of the fittest has become the only seat in England of the industry introduced by Kraus. As for the needle itself, it has continued nearly if not exactly the same, with point, eye, and polished shaft, ever since its introduction until the present year. There have been improvements made from time to time in the process of manufacture, and hand-work has of late been to a great extent superseded by machinery; but the form of the article itself has remained the same. It seems, however, that the year of Jubilee has been signalised by the introduction of an improvement in the make of the needle which promises to revolutionise the trade, and which certainly should bring joy to the heart of many an aged needle-woman with failing sight; we refer to the invention of the "calyx-eyed" needle, for which also this country is indebted to a German, Mr. E. Kratz. The object of the new invention is to dispense with the necessity for passing the end of the cotton through the eye, an operation which, in the case of small needles and persons with bad sight, is attended with considerable difficulty and no little vexation. The threading is accomplished by merely drawing the cotton through a slit above the eye; and the old method, which has been termed, in a serio-comic spirit, one of the

remaining grievances of civilisation, is thus, we trust, for ever done away with. But how is it, people may ask, that the thread which passes in so easily does not easily slip out again? The explanation is very simple. Below the eye is a second opening; and the two together form a spring which opens to admit the cotton, and closes when the cotton is safely lodged inside. It is evident that for the formation of the eye of this newly-invented needle the most delicate manipulation is required, and also a perfect temper in the sides of the eye itself; nor can we suppose that these two requisites would anywhere be more certainly obtainable than in the establishment of Messrs. Milward & Sons, the largest and most complete needle factory the world has ever yet seen.

After the needles are made the work of the manufacturer, however, is not yet finished, for many important processes have still to be undergone before they are in a fit state to be sent out from a first-class factory. Among these we must mention the process of hardening, which requires great skill and experience; the process of brightening; the process of picking out all defective needles, which is done in the Washford and Forge Mills with the utmost care; the process of polishing, for which Messrs. Milward have an advantage over other makers in the possession of machinery invented and patented by themselves; and finally the process of fixing the needles in papers ready for the market. Needles of every description and size are among the goods sent out from these Works, including those for hand-sewing, for tailors, for dress-makers, and for milliners; every kind in daily use by the needle-woman, whether for hand-work or for

THE WASHFORD MILLS AT THE QUEEN'S ACCESSION.

THE REDDITCH MANUFACTORY AT THE QUEEN'S ACCESSION.



WASHFORD AND FORGE MILLS, REDDITCH.

machine-work; packing-needles, knitting-needles, crewel-needles, and a number of other varieties which we have not even space to name.

In concluding this article, we must mention also the fish-hook department of Messrs. Milward & Sons' Works, whence a large quantity of goods are sent to all the fisheries in the world; and we must also put our readers on their guard against unscrupulous attempts to pass off spurious goods as coming from the Works of Messrs. Milward. The names, marks, and labels of the Firm should always be carefully identified.

Sir W. G. Armstrong, Mitchell, & Co., Limited, Newcastle-upon-Tyne.

PREPARATION for war has been held to be the best security for peace. Granting the truth of this axiom, it will be acknowledged that although this "ALBUM" is mainly devoted to chronicle the triumphs of the Arts of Peace, there is an appropriateness in including therein the history of a Firm which, by improving our weapons of defence, has materially contributed to insure for our commerce and industry that degree of security which is so essential to their prosperity. The Firm of Sir W. G. Armstrong, Mitchell & Co., Limited, may therefore well claim an honoured place in these pages. The manufacture of Ordnance involves a variety of processes so complicated and intricate in their nature, and partakes moreover of so purely a scientific character, that it is well-nigh impossible to elucidate the subject by mere description and without the aid of a large number of illustrative diagrams. We shall therefore not attempt the task; it being, moreover, outside the province of this work to enter here upon a consideration whether iron or steel, whether breech-loading or muzzle-loading, whether smooth-bore or rifle-bore, is preferable; nor shall we seek to discuss any of the other more or less important points which have at times given rise to warm discussions among those who may be regarded as authorities upon the subject.

We must content ourselves by saying that within the last twenty or thirty years an unprecedented advance has been made in the art of gunnery. It is worth adding that, although the nation supports huge establishments for the manufacture of ordnance, all the improvements effected within recent years are due to the inventive skill of private manufacturers. Foremost among these stands out the name of Sir William Armstrong. The Elswick Works, with which his name is indissolubly associated, were established in 1847, and were originally devoted exclusively to the manufacture of hydraulic and other machinery. In 1858, after an exhaustive series of artillery experiments, the manufacture of guns was added, and this brings us to speak of the highly-gifted man who laid the foundation of a business whose renown may be truly claimed to extend over the whole civilised world.

Sir William George Armstrong was born in 1810, at Newcastle-upon-Tyne. Destined for the law by his father, he was articled to a leading local solicitor, whom at the expiration of his term he joined as partner. From early youth he had, however, evinced a strong taste for mechanics and chemistry, and when only twenty-eight years of age he devised some important improvements in hydraulic machinery, and in 1845 he invented an hydraulic crane. One of these was shortly afterwards erected on Newcastle quay, where its superiority over those previously known was soon demonstrated. The hydro-electric machine, also introduced by him, led to his being elected when quite a young man a Fellow of the Royal Society. His many applications of hydraulic power to practical purposes, such as the opening and closing of dock gates, the raising of weights at harbours and in warehouses, &c., soon established for him a high reputation as a practical engineer. Following the natural bent of his mind he subsequently severed his connexion with the law, and,

in conjunction with some friends, established the Elswick Engine Works. He next devoted his attention to the improvement of ordnance, and after several years' experiments he contrived the rifled gun that bears his name.

Both in structure and action the new guns were so vastly superior to every type of ordnance previously known, that the Government, about the year 1858, proposed to secure the result of these experiments to the nation. With a patriotism and liberality which stand probably unparalleled, Sir (then Mr.) Armstrong offered to make over to the Government, without any reservation whatever, all his highly important inventions. This generous offer was accepted, and the subject of our present sketch was appointed Chief Engineer of Rifled Ordnance, and in recognition of his eminent services and liberality to the nation he was about the same time knighted by the Queen. Down to the year 1863, the manufacture of ordnance at the Elswick Works was carried on practically as a Government establishment. In that year the contract with the Government came to an end, and after this the Works were conducted as a private concern, until December, 1882, when the Firm was converted into a Limited Liability Company with a capital of £2,000,000. The newly-formed Company took over the businesses of Sir W. G. Armstrong & Co., and of Messrs. C. Mitchell & Co., shipbuilders, both of which were then amalgamated.

The Elswick Works have not their equal in their own branch of manufacture. They are situate on the banks of the River Tyne, near Newcastle. They have a frontage of about a mile, and an average width of 150 yards. Altogether they cover some forty acres, and give employment to 10,000 workpeople, as compared with 200 when originally established forty years ago. Some of the boring and rifling tools here employed are the largest and most perfect specimens of their kind ever made; and everything throughout the long series of factories—including casting, welding, fitting, rifling, and shell-making departments—is contrived on a most extensive scale; and it will help to bring this fact home to the reader when we mention that the new plant laid down a few years ago cost upwards of £200,000.

The leading feature of the guns here manufactured consists in the coiling of one wrought-iron tube over another until a sufficient thickness has been built up. The ordnance produced ranges from the smallest up to the 110-ton guns, several of which latter have been manufactured both for our own and for foreign Governments. As showing the productive capacity of the Works we may mention that more than 4,000 guns of all descriptions have been made here. The Armstrong guns form, indeed, part of the armament of most nations, and it has been well observed that they are in daily use in all countries, from Russia to the Bonney River. Sir William Armstrong has down to the present time continued to take a leading part in the development of artillery and other implements of war, and the establishment over which he still presides as Chairman is the largest and most important private ordnance manufactory in the world.

In 1863 he acted as President of the British Association on the occasion of its meeting in Newcastle-upon-Tyne, and he then drew attention to the gradual exhaustion of our coal supply. This led to the appointment of a royal commission of inquiry, of which he himself was nominated a member. Various distinctions have at different times been conferred upon him, both at home and abroad. In 1862 he received the honorary degree of LL.D. from Cambridge University, and in 1870 the D.C.L. from Oxford. He is also a Knight Commander of the Austrian Order of Francis Joseph, of the Danish Order of the Dannebrog, of the Brazilian Order of the Rose, and a Grand Officer of the Italian Order of SS. Maurice and Lazarus.

The great Elswick Firm does not confine its attention exclusively to the manufacture of ordnance and hydraulic and other machinery. As recently as April of the present year there was launched from the Elswick yard the new armour-clad warship *Victoria*, which had been nearly two years in building. The completion of this ship marks a new departure in naval construction, the *Victoria* having been built and provided with her armaments and her machinery at these Works. This is, we believe, the first and only instance upon record of a war-ship having been thus completed throughout by a single firm. The present ironclad measures in length 340 feet, and in breadth 70 feet; she is of 12,000 horse-power, and her displacement is 10,500 tons. She is protected by armour 18 inches thick, and carries as her armament two 110-ton guns, one 30-ton gun, twelve 5-ton guns, twelve 6-pounder quick-firing guns, nine 3-pounder quick-firing guns, besides machine-guns for smaller ammunition. She has also a powerful ram and eight torpedo dischargers. The new vessel is expected to make seventeen knots per hour, or, to put it in another way, she could remain at sea, at a high speed, for a distance of about 5,000 knots, which is nearly the distance from here to New York and back. It will thus be seen that the *Victoria* is a vessel of which, according to present promises, the builders may well

be proud, and the perfection of her armaments will help to insure for the Firm a continuance of the high repute which has been so well upheld during the last thirty years.

As illustrating the great variety of guns made at the Elswick Works, reference may be made to the imposing ordnance trophy erected in the Main Court of the Royal Mining, Engineering, and Industrial Exhibition now being held at Newcastle, which was opened on the 11th of May of the present year by the Duke of Cambridge. This trophy comprises every variety of weapon manufactured by the Firm under notice. Their famous 110-ton gun is only represented by a model, it having been found impossible to secure a vehicle capable of conveying the gun itself to the Exhibition. With this single exception all the other guns are, however, real pieces of ordnance, and thus bear striking evidence to the marvellous resources of the Works.

In preference to using any words of our own relative to the devoted labours of Sir William Armstrong (upon which and their national importance we have been able only to touch here very briefly), we will quote Lord Brassey, one of the greatest of living authorities on marine armaments. At a time when he was himself connected with the Government, Lord Brassey was fain to acknowledge that a spirit of enterprise had been uniformly displayed by the subject of the present sketch which had been wanting at Woolwich—which sentiment will be echoed by all who are conversant with recent history. Though advanced in years, Sir William Armstrong still takes a keen interest in all that relates to improvements in ordnance, to the furtherance of which he continues to devote his inventive faculties and exceptional abilities. The practical management of the Works has, however, for some years past fallen to his partners, and since July, 1882, when the Firm became a limited Company, to a managing Committee of the Board, of which Captain A. Noble, C.B., is Vice-Chairman.

The late Sir Joseph Whitworth.

HILST these pages were in progress of compilation a great man has passed away from our midst. Born on the 21st December, 1803, at Stockport, in Cheshire, Joseph Whitworth was educated under his father's supervision until his twelfth year, and finished his education at an academy near Leeds. At the age of fourteen he was sent to an uncle in Derbyshire, the owner of an important cotton mill, with whom he remained for four years and a half. This appears to have been the first opportunity afforded him for acquiring a thorough knowledge of machinery. He then went to Messrs. Crighton & Co. at Manchester, and after remaining there four years he came to London and passed through the important establishments of Messrs. Maudslay and Messrs. Holtzapffell and others. In 1833 Mr. Whitworth returned to Manchester and commenced business as a manufacturer of engineer's tools. In 1840 he read an important paper before the British Association at Glasgow; and his theories therein propounded were shortly after adopted by leading manufacturers. Many and varied are the useful improvements which his active mind created. At the Great Exhibition in 1851 he was an important exhibitor, and received the Council Medal, a mark of great distinction. To him was accorded the rank of one of the foremost mechanicians of the age. In 1853 he was appointed a Royal Commissioner to the Exhibition in New York. After this he constructed, at the request of the Government, machinery for improved precision of firearms. From this time forward Mr. Whitworth was regarded as one of the leading authorities in all that appertained to guns and armoury. In 1857 he was elected a Fellow of the Royal Society; he was also LL.D. of Dublin and D.C.L. of Oxford. He gained the Grand Prize at the Paris Exhibition in 1867, and in the following year received from the Emperor Napoleon III. the Cross of the Legion of Honour. In 1869 Her Majesty conferred on him the honour of a baronetcy in recognition of his distinguished acquirements; he also obtained the Gold Medal of the Society of Arts, and in 1878 he gained for the Firm of which he was the head three grand prizes for various machine tools, as well as a Gold Medal for the celebrated breech-loading "Whitworth" gun.

The relations existing between himself and the workmen in his employ were ever of the most cordial character; his own words will best illustrate this. Writing on this subject in 1877, he said—"The relations between foreman engineers and their employers have lately become of a much more intimate character, particularly in concerns which have availed themselves of the Limited Liability Act. The foreman engineers have themselves become employers. Three years since, on March 31, 1874, I converted my business into that of a Company, but not in the usual sense of asking the public to take shares in it. Myself, the foreman, and others in the concern, twenty-three in number, hold 92 per cent. of the shares and have practical control, while the remaining 8 per cent. of the shares are held by others."

It may truly be said that the world owes him much for his guidance and direction in the important field

of mechanical science. His liberality and thought for the coming generation is demonstrated by his munificent gift of £100,000 to form Scholarships for certain mechanical subjects, varying in value from £100 to £200. This scheme was set forth by him in a letter to the then Right Hon. Benjamin Disraeli, M.P., as follows:—

MANCHESTER, *18th March*, 1868.

SIR,—I desire to promote the engineering and mechanical industry of this country by founding thirty Scholarships of the annual value of £100 each, to be applied for the further instruction of young men, natives of the United Kingdom, selected by open competition for their intelligence and proficiency in the theory and practice of mechanics and its cognate sciences.

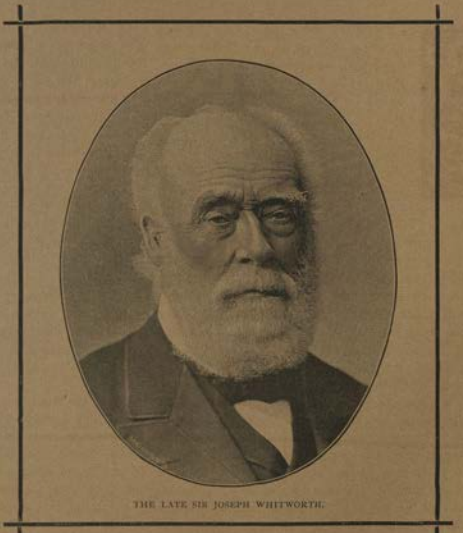
I propose that these Scholarships should be tenable on conditions to be defined by a deed of trust regulating the administration of the Endowment Fund during my life, and that thereafter the management of this fund, subject to the conditions specified therein, should vest in the Local President of the Council or other Minister of Public Instruction for the time being.

I venture to make this communication to you in the hope that means may be found for bringing science and industry into closer relation with each other than at present obtains in this country.—I am, &c.,

JOSEPH WHITWORTH.

To the Right Hon. B. Disraeli, M.P.

This princely offer was gratefully accepted, and has since been the means of fostering much otherwise neglected talent, and of raising the technical proficiency of the large number of engineering students who have been thus benefited.



THE LATE SIR JOSEPH WHITWORTH.

This great man is no more; but he will be held in ever grateful memory by thousands. "Raised by his Sovereign to rank and title, he leaves his monument in the workshops of the world." We are indebted to the courtesy of Mr. Whitfield for the portrait (the last that was taken of the late Sir Joseph Whitworth) which appears in this short record of his life and work.

Messrs. Bass, Ratcliff, & Gretton, Limited, Burton-on-Trent.

EVERYBODY knows that Pale Ale is a great institution all the world over. At the head of our paper we have placed the name of a firm who may, without hyperbole, be pronounced to be, in the quantity and the quality of the Beer they produce, incontestably peerless. As regards the *quality* of their productions it would be wholly superfluous to amplify the favourable opinions universally expressed. Bass's Pale Ale is known and highly appreciated far beyond the confines of England. Every one has heard a thousand times that "the Queen's morning drum never ceases to beat, and that the sun never sets, upon her dominions." Bass's Pale Ale is found in the remotest corner of these dominions, and the natty scarlet triangle that constitutes the trade mark, and indicates the genuine nature of the contents of the bottle, is ever hailed with welcome. But it is not only Colonials and English-speaking people that appreciate Bass's Ale, its exceeding goodness is known to a multitude of people of divers kindreds and tongues. A veracious narrator has assured us that in Central Russia a young grandee will give his most distinguished friends as a treat a bottle of Bass, which is prized more highly than the oldest and finest Johannisberg. So highly is the precious ambrosial nectar esteemed, indeed, that it costs 12*s.* 6*d.* per bottle, and hosts and guests sip it with silver teaspoons! The Firm are naturally jealous concerning the high reputation they have acquired, and desirous that it should remain untarnished. In any case detected, of Pale or other Ale being sold as from Messrs. Bass & Co. that is not their genuine brew, the account, if the delinquent has one, with Messrs. Bass & Co., is peremptorily closed, and if an action will lie for imposition on the public or for infringement of trade-mark, the action will be raised and prosecuted,—and most properly so, say Honour and Honesty.

It is not by accident that a celebrity like that of which Messrs. Bass can boast is acquired. It is entirely deserved, and is the natural result of an enlightened system of business long continued. Messrs. Bass & Co. go into the market to buy the best barley obtainable for malting, and invariably pay the top price for hops, as well as for barley, taking care that they get the best quality of each. With them quality is the prime consideration to which all others yield, and no one can compete when Bass & Co. are in the market as buyers. The Firm claim that their Ale is pure, and consists of the best water, the best malt, and the best hops, and of these elements only, combined by the best professional, chemical, and mechanical skill and appliances available.

The breweries of Messrs. Bass & Co., of Burton-upon-Trent, are the largest establishments of their kind in the United Kingdom, and therefore we may say, in the world. Burton, as a town, is of considerable antiquity, but has no more remarkable feature than its breweries, for which it is indebted primarily to the excellence of its water, but not less to the skill and enterprise of the heads and managers of the different brewing firms, who have taken full advantage of Nature's peculiar bounty in this respect.

The railway system has done much to develop the staple business of Burton—its production of Beer

but Bass, the Burton brewer, had established the business, and acquired a good name, long before railways were dreamed of. We shall be carried a long way back if we attempt to imagine the condition of things and the surroundings that prevailed at the time Mr. William Bass established, in the year 1777, the brewery that was the germ of the great business of his grandson, Mr. M. T. Bass. Mr. W. Bass established what was in that day deemed a large concern; he supplied a glass of very good sound pale, amber, or brown Ale, as his customers might desire, and laid deep and solid the foundations of a brewery that has no equal. Previously to the year 1777 he was, moreover, proprietor of a carrying business, which he subsequently transferred to the celebrated House of Pickford & Co., when he found the increasing trade of his brewery demanded his undivided attention.

What a marvellous contrast between the first brewery of Mr. William Bass, the founder of the Firm, and the establishment as it is now! This brewery was built, probably, upon a plot the size of a moderately large garden. His descendant now occupies freehold business premises extending over 45 acres of freehold of the value of £250,000, and over 100 acres of leasehold property. His "power" in the brewery was probably altogether manual, helped in some processes, possibly, by a horse (James Watt was not fully fledged, nor his engine fully developed then; Watt was at that time battling with the Cornish mining captains); now, Bass & Co.'s Brewery has 34 steam-engines of 720-horse power in the aggregate, and two portable engines of 26-horse power. Mr. William Bass had for locomotive purposes heavy cart-horses, that dragged their loads over rutty roads,—the same rutty roads by which the barley for malting, and the hops, and other materials, were brought into the brewery. His descendants work their traffic, in part into and out of the premises, by ten locomotive engines, their own property, that have the power of 1,000 horses; and they have 100 powerful cart-horses employed besides. In addition, since then, Brindley has done his work, and shown others how to do it, by water-ways, and George Stephenson has done the same by railways; and the Burton breweries have access now, by railways, roads, and canals, not only to the nearest towns and villages by difficult and tardy progress, but, easily and quickly, to all parts of the country and of the world. Moreover, the Firm have direct connexion with these outer railway systems by twelve miles of railway on their own premises, and working arrangements with the Midland Railway Company over seven miles of their branches. Mr. William Bass may have sometimes, in busy seasons, employed an extra horse and dray or so; well, supposing he had six or eight of these in a train,—that is, passing out or in close behind each other,—some forty yards would be covered by them: now, however, the Firm use as many as 40,000 railway trucks in the course of six months, and often as many as 370 trucks in a day, and these placed close together would make a train one mile and 453 yards long; or would reach, say, from the Marble Arch, Hyde Park, along the whole length of Oxford Street, to the beginning of Holborn. Mr. William Bass could possibly tell almost every one of the casks he had in use in his business by head-mark, or enter the whole of them on a page of his Cash Stock-book. What a tremendous page it would be that would receive the numbers of the casks belonging to the Firm now! The stock of casks necessary to carry on the business consists of 40,499 butts, 134,464 hogsheads, 127,592 barrels, 147,969 kilderkins, and 68,597 firkins; in all, 518,121 casks.

Owing to the adoption of mechanical and scientific appliances, where the worthy founder of the Firm employed ten men his successors employ only one; and yet they need the services at Burton of nearly 2,250 men and boys, in addition to hundreds of others to manage their places of business in London, Liverpool, Manchester, Newcastle-on-Tyne, Birmingham, Stockton, Leeds, Sheffield, Wolverhampton, Stoke, Brighton, Edinburgh, Glasgow, Dublin, Cork, and numerous other places. The wages paid by the Firm at Burton alone, where manual labour is so largely superseded, nevertheless amount to over £2,550 per week. There are also 185 managers and clerks, the weekly average of whose salaries is £760. Mr. W. Bass commenced, probably, with the production of a comparatively few barrels a week, and delivered almost all the Beer he brewed by his own carts. Now, in the course of an ordinary brewing season, the Firm send out over 800,000 barrels, and receive into the works during that time raw material weighing 85,000 tons. The first brewery erected by Mr. W. Bass, a little more than a century ago, has been enlarged from time to time until the germ has been almost lost in the present immense concern. A second brewery was built by the Firm in 1853, and has been repeatedly enlarged. The foundation of a third brewery was laid on the 18th May, 1863, and was in work on the 25th January, 1864, only thirty-six weeks after beginning to build. The second and third breweries have been greatly enlarged to meet the growing demand, to an extent equal to a fourth new brewery; and the old brewery has also been entirely rebuilt on an enlarged and more convenient plan. It is scarcely possible to convey, by the use of words, an idea of either the magnitude or the character of

the operations and processes carried on at the three breweries of Messrs. Bass & Co. To produce such an impression, a series of panoramic views would be necessary. A few details may, however, somewhat assist the imagination. The new brewery consumed more than five millions of bricks in its erection; the main block is 700 feet long, with an average breadth of about 108 feet. The building has a ground-floor and first, second, and third floors, which give an average floor-space of more than six acres. The racking-rooms on the ground-floor cover an area of 7,691 yards, or considerably more than 1¼ acre. There are also on the ground-floor three engine-rooms and other accommodation. The tunning and mashing rooms are on the first floor, with rooms for storing and grinding malt. The fermenting-rooms occupy the second story, and the coolers and copper-house the third. The tunning-rooms are of the same area as the racking-rooms, and contain 2,548 tunning-casks of 160 gallons each. The mashing-rooms have twelve mash-tubs, each of which will deal with sixty quarters of malt. From the malt-rooms the malt as ground is raised by a chain of cans, attached to a revolving belt, into a trough 16 feet high, from which it is sent

THE LATE MR. MICHAEL THOMAS BASS.

forward by an archimedean screw to the malt-hoppers over the mash tubs, ready for use, to be dropped into the tubs as required. The fermenting-room has 159 squares or vats, each containing 2,200 gallons. The coolers are supplemented by four large refrigerators, capable of cooling 250 barrels of wort per hour. The copper-house contains three water-coppers that will boil 12,000 gallons each, and eleven wort-coppers that will each boil 2,200 gallons of wort. There are also three hot-water tanks adjoining the brewery, for the supply of boiling water for washing and brewing purposes; these are heated from circulating boilers and hold 15,000 gallons each. Over the copper-house there is a large water-tank that commands the whole premises. It is supplied by engine-power, the water being pumped from wells on the premises.

In connexion with the new brewery, a new Cooperage and three large Malt-houses were erected, also immense Hop and Ale stores of a total area of nearly six acres, and capable of containing 20,000 pockets of Hops and about 60,000 barrels of Beer. Here it may be mentioned that a large mechanical trade, created by the brewery as a necessary adjunct, finds ample employment that would in itself be deemed sufficient for a prosperous business, there being no fewer than 400 men and boys engaged in the cooperage, in which very ingenious machinery is employed, under the direction of an efficient manager and a number of competent foremen. The large demands upon the cooperage may in some degree be appreciated

when it is stated that the Firm export to foreign countries, every year, about 25,000 casks, which, placed end to end, would cover a line of more than 15 miles. These casks are not returned for the most part, and the coopers have, moreover, to make good the wear and tear in the enormous stock of casks used in the home trade of the Firm.

The Firm have 22 maltings at Burton. At the Shobnall premises, in addition to immense Ale-cask and Stave wharfs, there are seven Malthouses—all communicating, and capable of malting about 60,000 quarters—which were erected at a total cost of over £100,000. Messrs. Bass & Co., moreover, have large establishments at Lincoln, and together they make, during the malting season, 7,588 quarters per week. Notwithstanding their great powers of production, the malting-houses are not adequate to supplying the wants of the concern, and malt has to be bought to the extent of about 20,000 quarters; but Messrs. Bass & Co. prefer malt of their own making, having always in view the best possible quality. The brewing is under the direction of gentlemen of the highest skill as scientific and practical chemists, and who are especially conversant with chemistry as bearing upon the art of brewing.

ALE AND HOP STORES, BURTON.

Reference should be made to the numerous radiating centres of business occupied by the Firm in various parts of the United Kingdom; and, it may be added, of the world. One of these that we have visited is situated in the locality that was once known as Agar Town, St. Pancras, London. The large block of buildings occupied by Messrs. Bass as stores adjoins the goods station of the Midland Railway Company, the railway communication between the interior of the stores and that of the breweries at Burton being continuous and unbroken. The buildings occupied by Messrs. Bass & Co. are four-sided, but not "four-square," being 300 feet each on two sides, 400 feet on another side, and only 100 feet on the fourth side. The Firm occupy three floors for the storage of their Ale, these floors having an aggregate area of not less than six acres. They are capable of storing 90,000 barrels. The quantity sent out ranges from 800 to 900 barrels per day. There is, besides, a large store under the Midland goods station used for export bottling purposes, capable of holding about 8,000 butts. In connexion with these stores, 120 men and 60 horses are employed continuously. The Firm have, besides the stores in London, also a Depôt at Poplar, for their export and Continental trade.

Messrs. Bass & Co., it should be stated, are the chief of twenty-eight firms of Burton brewers, who represent nearly one-tenth of the entire brewing-trade of the United Kingdom. When the cotton-trade—the leading

industry of this country—was disturbed by reason of the Civil War in America, we all remember the profound anxiety its condition caused to our leading statesmen. Only second in importance and amount to cotton come Beer and its congeners, and yet, marvellous to relate, some of our would-be statesmen and legislators, with rash and ill-considered schemes, would disorganise this vast interest, with its capital of £117,000,000 and its formidable army of 1,500,000 dependents! What wonder, when we reflect not only upon the industrial but also the social bearings of the question, that any interference with the national beverage—the poor man's pint of beer—is jealously regarded, while stringent measures have recently been adopted to prevent tampering with

LORD BURTON.

its purity. No doubt reform in the drinking habits of this country is desirable; but no apprentice-hand should undertake to effect this. The statesman who shall succeed in making England a more sober nation will deserve its everlasting gratitude, and secure for himself undying fame. Meanwhile, the people are yearly becoming more sober, and towards that result no agency has contributed, or is contributing, more than the Firm of Bass, Ratcliff, & Gretton—the biggest brewers of the best Beer in the world.

The present head of the firm is Michael Arthur, born in 1837, eldest son of Michael Thomas Bass, whose portrait appears in this article. He was M.P. for Stafford (1865–68), East Staffordshire (1868–85), Burton Division (1885–86), and created a peer by Her Majesty, under thetitle of Lord Burton, during Mr. Gladstone's last administration.

Messrs. Ind, Coope, & Co., Limited, Romford, Burton-on-Trent, and London.

ROAST BEEF, washed down by nut-brown ale, has been looked upon from time immemorial as the proper basis of a real old English feast. Foreigners have tried to imitate the national beverage of John Bull, but their attempts have always been the reverse of satisfactory. British beer is famous all over the world for its nourishing and stimulating properties; but it will be well to take a brief glance at its early history before further referring to its merits. The art of brewing was known to the Egyptians many centuries before the Christian Era. By them it was transmitted to the Greeks, by whom it was taught to the Romans and ancient Gauls. It was the latter people who were the means of first introducing it into England. Herodotus states that the Egyptians, being without vines, made wine, or beer, from corn. They called it "Zythum," or "Barley-drink." Archilochus, of Paros, poet and satirist, refers frequently to beer, and Pliny discourses learnedly on its quality, calling it "Cerevisia," evidently from Ceres, the Goddess of Corn. The Saxons, after subduing Britain, began to civilise the natives, and, among other arts, taught them how to make beer from wheat. In the reign of Henry II. the monasteries of England were famous for the strength and purity of their beer. A document, yet extant, dated towards the close of the twelfth century, grants a lease of land to the Abbot of Burton-on-Trent, the rental payable being two gallons of monastic beer and one penny and seven gallons of inferior beer. The great brewing Firms of England would doubtless be glad, in these "degenerate" days, to acquire additional land contiguous to their premises on similarly favourable terms.

Having glanced at the ancient history of beer-making, and shown how, by virtue of long practice, the English have won substantial fame as brewers, we will now proceed to present to our readers an account of one of our most famous breweries.

Having obtained permission from Messrs. Ind, Coope, & Co. to visit their great Brewery at Romford, in Essex, we seated ourselves early one morning lately in a Great Eastern Railway carriage at Liverpool Street Station, and in less than half-an-hour reached our destination. On approaching the town, the most prominent feature of the place became apparent from the railway station, for the vast buildings and surroundings of the Romford Brewery would certainly engross the attention of the most casual observer.

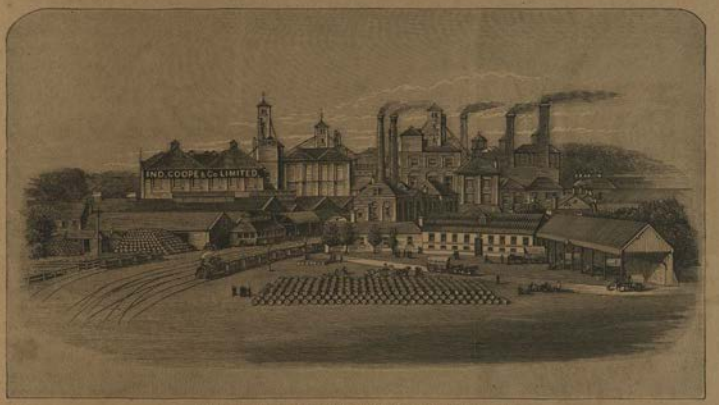
The Firm of Ind, Coope, & Co. are evidently foremost amongst the leading brewers of the world. Their history goes back to 1799, when it was founded by Messrs. Ind & Grosvenor, but on Mr. Grosvenor's retirement it became Ind & Smith. About forty years ago Mr. Smith was succeeded by Mr. Octavius Edward Coope, and subsequently Mr. Matthews joined in partnership. Since that time the Firm has been carried on under the style and title of Messrs. Ind, Coope, & Co., but is now presented, an incorporated body of vast capital and experience, as Ind, Coope, & Co., Limited. It is as well, however, to note that, although the Company has been incorporated under the Limited Liability Act, no shares were offered to

the public; the original partners of the Firm now constitute, as they before did, the sole proprietors thereof.

Mr. Edward Murray Ind, one of the Directors, was last year elected Chairman of the Licensed Victuallers' Schools and Asylum, and marked an epoch in the history of that benevolent institution by a timely donation from himself, friends, and staff of assistants, amounting to the munificent sum of £2,031 sterling; a gift which cannot fail to afford us an insight into the kindly character of the donors.

To return to the Brewery at Romford. The premises stand on fourteen acres of land, of which nine acres are occupied by buildings suitable to the general requirements of this very large brewing establishment. The remaining space is devoted to railway, storage, and to other purposes necessarily connected with the immense operations of the Firm.

We were first conducted by an able representative to the mill-room, where malt, all ready for the purpose, is ground, and its product carried by machinery to the mash-tuns, the entire plant of which holds 350 quarters at a time; but before the malt is thus treated it is stored in the malt-room in thirty-two



VIEW OF MESSRS. IND, COOPE, AND CO.'S ROMFORD BREWERY.

bins, which are made to hold large quantities of grain, which is delivered to the mill-room by means of appropriate contrivances called Jacob's ladders. Brewing on the scale we witnessed at Romford scarcely admits of a minute description of all the processes connected with it, and it would become tedious to the reader to follow us step by step through the details of the immense establishment of Messrs. Ind, Coope, & Co.; we shall, therefore, content ourselves with noting that all the most approved methods and labour-saving appliances extant have been adopted by the management, and that in every particular the most scrupulous and exacting cleanliness is "the order of the day." Four hundred employés are constantly at work on the premises, skilfully superintended in every department by experienced managers, so that the best possible results may be obtained.

Two large engines of aggregate 70 horse-power are necessary to keep the brewery machinery in motion, and no less than seven large boilers are here called into use. These, as a matter of course, entail a wonderful consumption of coal, and that item alone costs the Company from £6,000 to £7,000 per annum.

Messrs. Ind, Coope, & Co. have their own railway sidings, and two locomotives are constantly kept for

the conveyance of their beers to the Great Eastern Railway Company's lines, to be delivered so as to finally reach the depôts in London and elsewhere for which they are intended.

The barrels used at the Romford Brewery are, in the first instance, purchased, and not made by the Firm, who have, however, to maintain a large number of coopers and working men for repairing and cleansing purposes in connexion therewith. The cleansing is accomplished by means of injected steam, after which cold air is forced through the casks to cool and dry them. Between two and three thousand casks per day are subjected to this necessary operation before they are considered fit to be passed to the "filling" department.

We now come to the storage rooms, where there is space for 30,000 barrels, and this number can be kept in stock all the year round; but even such large provision is quite inadequate to the Company's requirements, and large stacks of barrelled beer, have to be kept, covered with straw, in the open air, in consequence of there being no room for them within the building.

The out-offices and stabling attached to the Romford Brewery are very extensive. The former comprise engineers' shops, replete with every modern appliance for the manufacture or repairs of the Firm's premises and plant; carpenters', blacksmiths', coppersmiths', painters' shops, and harness-makers' work-rooms, fully occupied by workmen, also combine to render most complete and economical the arrangements made for the efficient working of this great commercial undertaking. The stables give shelter to forty noble-looking horses, which are used for local purposes only, and this department is presided over by those who know that to treat their faithful dumb auxiliaries well is the surest way to gain the confidence and good-will of their employers.

The hop-rooms, one over another, next attracted our attention; they constitute a noble building, and are generally stocked with, at least, 3,000 bales and pockets of the finest Kentish and other hops.

A well-appointed fire brigade of the employés, which commands the service of two manual and one steam fire-engine, is made responsible for the safety, from fire, of the entire buildings.

We may now appropriately mention that when at Romford, we were fortunate enough to taste a sample of the light bitter ale which the Company brew for export to India and the Colonies, to meet the large demands which constantly reach them for that article, and judging from the ever-increasing business of this character, it seems to be much appreciated in whatever part of the world to which it may be sent. From a long acquaintance which we have had with tropical climates and those who reside in them, we can sincerely congratulate the future consumers of this pleasant and excellent beverage.

To ensure the brews for foreign export reaching the consumer in the very best condition the Company have their own stores at the Victoria Docks, where a large staff of men and boys are constantly engaged in bottling their ales for that purpose.

Having very briefly described what we saw at the Brewery at Romford we would, ere we conclude our pleasurable task, enter into a few details relating to Messrs. Ind, Coope, & Co.'s offices, workshops, and stabling, situated in Osborn Street and Great Garden Street, London, E. These premises consist of the London Head Offices, and other extensive buildings, where one or more Directors of the Company are daily to be found. They are assisted by a competent staff of managers, clerks, and travellers, and we venture to say an idle man could not be found within its precincts. It was in Osborn Street we had also pointed out to us ranges of workshops, which were occupied by blacksmiths, wheelwrights, sign-makers, sign-painters, sign-writers, &c., who were all busily engaged at their respective occupations, under competent direction.

The Company's own workmen repair the buildings, drays, and covered carts, and also manufacture all the new conveyances required. There is also a store-room here for Romford ales, which contains stock to enable "immediate" indents to meet with prompt attention. The nature of the brewing business, as a matter of course, necessitates the use of many valuable horses, and we were shown some splendid teams belonging to Messrs. Ind, Coope, & Co., which it would be hard to surpass for strength and beauty, all the world over. Their drivers, who are all picked men, are very proud of these noble animals.

To facilitate the delivery of goods ordered at the London offices, there are also two large stores at Bishopsgate, to which point is despatched from Romford, daily, a special train, frequently supplemented by a second train service, conveying barrels of ale, stout, and porter, required by the wholesale bottlers, grocers, and private customers, who on a moderate computation take many millions of gallons of the Firm's ales in the course of a year. To give some idea of the perfect organisation of this great concern, it will be sufficient to state that all orders are guaranteed delivery within a day of their receipt at any of the Firm's offices

and depôts, to the following places, viz. :—Brentford, Brighton, Chatham, Croydon, Eastbourne, Enfield, Greenwich, Hastings, Redhill, Stratford, Surbiton, Watford, Windsor, Woolwich and Worthing. In connexion with the Company's Brewery, agents will be also found in all the principal cities and towns in Great Britain.

The Great Garden Street stabling belonging to Messrs. Ind, Coope, & Co. is situated within a short walking distance from the London Offices, and there we saw that the most perfect accommodation was provided for a large staff and one hundred and thirty-five horses, which find constant employment in delivering the justly celebrated Romford ales and stout to families who reside in and near London. One hundred men are here employed: the Superintendent of the Stabling Department lives on the spot, and has his offices, clerks, and staff of farriers, blacksmiths, and others, to assist him in the performance of his onerous duties.

The stables themselves are patterns of cleanly and neat arrangement; a hospital for horses temporarily indisposed, isolated on sanitary grounds from the rest of the animals, is provided, and from what we saw "no stone was left unturned" to secure the comfort and well-being of both men and animals who have the good fortune to serve in the vast establishment of Messrs. Ind, Coope, & Co.

It may be interesting to our readers to know that, encouraged by the great success of the Romford Brewery, Messrs. Ind, Coope, & Co., in 1856, established, under the direction of Mr. Matthews, a partner in the Firm, an important branch at Burton-on-Trent, which is now well-known as one of the three great breweries of that famous beer capital. It occupies a site of thirty acres of land, and has storage-room for 30,000 casks of ale, whilst the output exceeds 250,000 casks per annum. It is hardly necessary to state that a very large number of men find constant employment there, and that the capital engaged to carry on this branch alone would be sufficient to effect "a King's ransom." A large proportion of the Burton-on-Trent supplies are sent to the Company's immense stores at St. Pancras, London, and it is from thence, the numerous orders received from "the trade" generally are complied with.

Messrs. James Brown & Co., Esk Mills, Penicuik, N.B.

AMONG the many industries which have been very largely developed during the reign of Her Majesty, Paper-making occupies a leading place; for, with the increase of every manufacture or industry, paper is required in larger and ever larger quantities, and this, coupled with the marvellous spread of education, has caused the demand to increase to such an extent, that it would seem to be indisputable that paper is now really *one* of the necessaries of life. Hence it is often stated, that the consumption of paper by any nation is a pretty fair index of its position in the scale of civilisation, which is in effect simply repeating a statement made 1800 years ago by Pliny, viz., "That all the usages of life depend in a remarkable degree upon the employment of paper."

The Chinese are generally credited with being the discoverers, at a very remote period, of the art of manufacturing paper out of prepared pulp (made from the bark of trees, bamboo-stems, rice, wheat-straw, &c.), but, up to about the year 1050, the natural paper *from the Egyptian* papyrus seems to have been the only kind available in Europe. After this date manuscripts are found written upon strong paper, evidently made from cotton and other materials; but the existence of any mill cannot be traced much further back than the commencement of the fourteenth century, when, both in Tuscany and Germany, mills driven by water power were in operation, though it seems to have been a century later before any mills were started in England. Caxton, in a book published in 1490, refers to a mill belonging to John Tate, of Stevenage, Hertfordshire, as producing fine paper:—

> Which late hathe in England, doe make thys paper thynne,
> That now in our Englyssh this booke is printed fynne.

In the following century a famous mill was started by Sir John Spielman at Dartford, regarding which it was written:—

> Six hundred men are set to work by him,
> That else might starve or seek abroad their bread,
> Who now live well and go full brave and trim,
> And who may boast they are with paper fed.

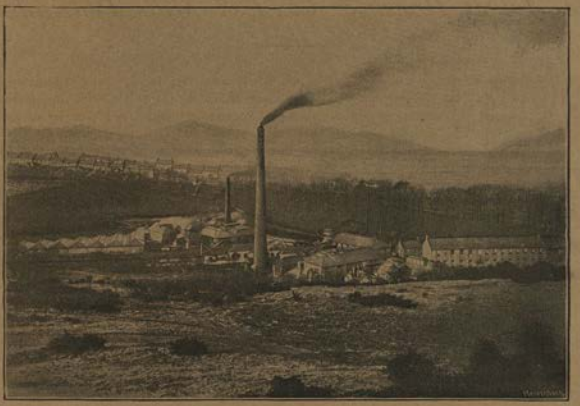
This mill was under Queen Elizabeth's special patronage, as she granted the proprietor a licence from 1588, "for the sole gathering for ten years of all rags, &c., necessary for the making of paper"; rags being then, and until quite recently, *the* raw material for paper, though now occupying a secondary place. Mills, after this date, gradually increased in numbers, and at the present day there are fully 350, and all well employed.

Up to the beginning of this century, paper was made entirely "by hand," sheet by sheet, in separate moulds. The process of continually dipping the moulds into the moist pulp was necessarily a very slow and laborious

operation, and many were the schemes and devices tried to overcome it, but the difficulty of transferring a wet film of thin pulp from the "vat" on to a "felt" in a continuous web baffled all experimenters, until one Louis Robert, a Frenchman, conceived the brilliant idea of a "Machine" having an endless web of wire-cloth travelling round and round, *on* which the moist pulp might flow in a *continuous stream*, and *from* which it might pass in a *continuous web* on to an endless felt, and then over drying cylinders at once. This idea was taken up in 1802 by the Messrs. Fourdrinier, stationers, London, who spent upwards of £60,000 in developing the "Machine," which is now, after many further improvements, a most ingenious and delicate piece of mechanism, whereby in less than five minutes a milky-looking fluid is transformed into a beautiful sheet of smooth, strong, and perfect paper.

Having now given a general outline of the history of the manufacture of paper, we propose to illustrate still further the present condition of the same by sketching the rise and progress of one of the oldest, most extensive and successful mills viz., that belonging to Messrs. James Brown & Co., Esk Mills, Penicuik, Midlothian.

The Works are situated in the beautiful valley of the North Esk, about three miles above the well-known



and picturesque scenes of Roslin and Hawthornden, and within eight miles from Edinburgh. Like most "old" mills, it is situated in a deep hollow close to the edge of the stream. A branch of the North British Railway passes close by, with a siding into the mill for goods, and a passenger station a few yards off.

The mill was begun in 1790 as a vat mill, employing only a few hands, and probably not turning out over one ton of paper per week. Trade shortly thereafter became very much depressed, owing to Continental wars, &c., and the proprietors were very glad to let their buildings for a short time to the Government to be used as a prison for French soldiers.

At the conclusion of peace, operations were resumed with increased vigour. New buildings were erected, new machinery was introduced, and one of the newly-invented Fourdrinier machines was set to work; powerful steam-engines were obtained, and an entirely new era was begun of continuous steady working, which has gone on without a break until the present day.

New appliances and new arrangements are still being continually introduced to improve the quality and finish of paper, to lessen the cost of production, and to increase the capabilities of the Works, the result being that, in the course of Her Majesty's reign, the turnout of paper has increased from ten tons to 100 tons per

week, or *tenfold*, and the quality and style are infinitely superior, while the cost of manufacturing has been reduced to a very great extent.

The principal raw materials used in the manufacture of paper,—such as that of which this book is composed,—are Esparto grass and rags, while for the finest writing-paper rags alone are still used; but, in the main, it may be stated that Esparto is now and has been for the last twenty-five years *the* raw material for paper. Many other fibres are used, such as chemically and mechanically-prepared wood-pulp, straw, jute, &c., but as yet these are principally used for special qualities of paper, generally of a lower class.

Esparto grass, as it comes from Spain and the North of Africa, is a long, silky, tough plant, of a beautiful straw colour, with a large amount of silica and resinous gum in its composition, and yielding about fifty per cent. of pure fibre; so that, roughly speaking, two tons of Esparto produce one ton of paper.

Our engraving shows the long range of sheds at the upper part of the Works, into which the Railway Company deliver the loaded wagons of Esparto, while other goods are run into the siding in front, from which they are distributed by the Firm's own locomotive to the various departments as required; and here we may remark that all through this mill (partly from the nature of the site and partly from skilful arrangements) the various departments fit into one another in the most admirable manner, thereby reducing the cost of manufacture to a minimum.

The various processes through which the raw material passes before it becomes finished paper, are dusting, boiling, bathing, bleaching, pressing, beating, making, calendering, cutting, sorting, and baling.

The Esparto bales are opened out beside the dusting-machine, into which the little sheaves of Esparto are thrown, to be tossed about and thoroughly opened out, whereby the dust and foreign matter are extracted by means of a powerful exhaust-fan, while the Esparto itself, now looking very much like loose hay, passes on to an endless series of felts, which convey it direct to the mouth of the boiler, into which it falls.

The boilers are so constructed that the moment the Esparto falls into them, it is violently beaten down by a continuous shower of boiling alkali, whereby the bulkiness of it is at once overcome, and a large quantity —2½ tons—is rapidly filled into a comparatively small boiler. Owing to the large amount of silica which the plant contains, the boiling operation—from its commencement to its close—occupies about eight hours. The Esparto is then withdrawn in a soft, moist condition, to be forked loosely into open vats, where it is bathed with tepid water and allowed to drip or drain itself free of traces of alkali, when it assumes a fine bright yellowish colour.

It is then removed to the bleaching-house, when it is forked into large oblong cisterns (each containing 20 cwt.) with semi-circular ends, and fitted with revolving knives, where it is pulped and partially opened out, and slightly rinsed with pure water at the same time. The bleaching liquor is then run in upon it, and the whole mass gently heated, until, at the end of about three hours, the pulp becomes pure white in colour, when it is at once emptied down to the "presse pate" machine, a most ingenious series of arrangements, whereby it is freed from any remaining sand or grit, and, at the same time, all knots, roots, pieces of heather, &c., are taken out, and the pure, moist pulp is delivered in rolls into boxes, pressed, and ready to put into the beating engines. We may mention here that the pulp has reached this stage of purity and cleanness without having had any picking or cleaning done to it by hand.

The pulp is now transferred to the beating engine, where the fibres are drawn out into a finely-comminuted condition, and where the colouring and sizing materials are added. This is perhaps the most important stage of the manufacture, and requires most careful and skilful attention, as the *border line* between finely-prepared "clear" pulp, and a mass of soft jelly is often very slight, the one condition being absolutely necessary for a fine sheet, while the other one is simply of no use whatever, as it will not "run" on the machine. The power required for this purpose is nearly 700 horse-power, and is obtained from a beautiful compound engine made by Pollit & Wigzell, Yorkshire, which runs swiftly from Monday morning to Saturday night, without variation and without noise. There are also many other smaller steam-engines and water-wheels in operation throughout the Works.

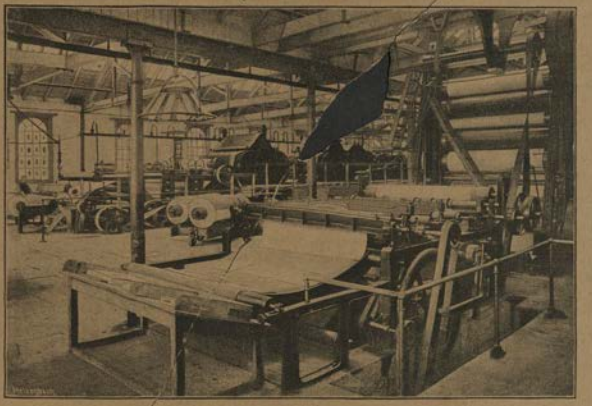
The prepared pulp is now run down to the paper-making machines, of which there are four (one of which we show in our engraving), where, as has been already stated, it is transformed into a beautiful sheet of fine paper. The engraving shows the general appearance and size of the machine, which is about 120 feet long, and delivers paper 76 inches wide at any speed between 20 feet and 150 feet per minute, according to thickness or quality required.

Paper which requires an extra high surface is then taken to the super calender (one of which is shown in

our engraving), which consists of cotton and chilled iron rolls, over and under which it is made to pass as often as may be required to get up the necessary gloss on the surface. These calenders are made very heavy and strong, and by means of compound levers enormous weight is brought to bear upon the rolls to give the needful polish upon the sheet.

The paper is then unwound off the reels on the cutting machine, when six or eight sheets can be cut at a time, and where nimble fingers of little girls are employed to square the pile of the cut sheets as they come flying wholesale off the machine.

The piles of paper are now passed in review by women, who turn over each sheet carefully, and then arrange them into three classes. The paper is next counted into "reams," which generally consist of 480 or 516 sheets. This is done by specially-trained young women, with a rapidity and accuracy most astonishing to the beholder; while it may be remarked, that one can imagine no more pleasant or cheerful employment for young women than this is.



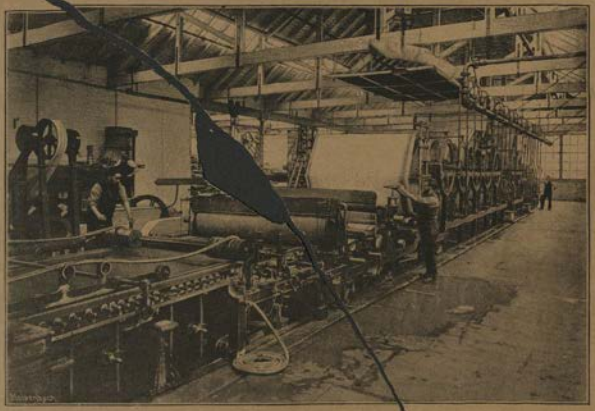
The paper has now only to be tied up, baled, and stamped, when it is ready to be loaded into the wagons (which come into the warehouse), and be sent off to the customer direct, or be retained until wanted. A somewhat unusual arrangement in this department may here be noted. Most Paper-makers at the present day find it necessary to have a warehouse or agent in London, but Messrs. Brown & Co. have been able to maintain their position in the trade without having one single agent or traveller, and store paper to suit customers' convenience in their large and suitable warehouses *at the mill*, from which, in these days of cheap telegrams and fast goods trains, paper can be despatched to any quarter at the shortest notice.

The various qualities of paper produced here are superfine and antique printings, plate, music, lithographic, and copy-book papers; those for illustrated magazines and periodicals, some of which have been supplied regularly for many years (*Chambers's Journal*, for example, since its commencement, more than fifty years ago); also writing and envelope papers (engine-sized), mill finished and friction glazed, of any size and quality. The total weekly production, as already stated, is about 100 tons, which, if run out into a strip of continuous paper one yard wide, of the thickness of the *Graphic*, would extend from Edinburgh to London and back again, or about 800 miles.

From our engraving, which, from [illegible] only shows a portion of the Works, it will be seen that the buildings cover [illegible] most substantial character, with abundance

of light and air, healthy and cheerful for the operatives, and lighted up at night mainly with the electric light (which is useful for matching colours), while in every department there is an ample supply of pure spring water, which is such an essential element in paper-making.

The plant and general machinery throughout the Works are of the newest and most approved types for efficient and economical working, while the arrangements for the re-use of waste liquors, and for the prevention of pollution of the stream, are admittedly of the very first order; and, in short, it may be stated that nothing which capital and skill can obtain is wanting to ensure success, for the proprietors thoroughly realise that in *this* case, at all events, the race is to the *swift* and the battle to the *strong*.



In taking leave of this most interesting department of industry, we are gratified to be able to state that the opinion of the proprietors of these Mills regarding foreign competition coincides with the statement lately made by the Royal Commissioners on the Depression of Trade, viz., that, despite Protection, cheap labour, indirect bounties, and the many undoubted advantages of Germany and other foreign countries, which have done so much of late to reduce the price of paper to such a very low point—despite all these, the British manufacturer need not despair, but rather, by the help of intelligent, educated workmen, careful and skilful management can fairly face this undoubted evil of *unfair* competition, and thus prove that in this case, at all events, Britons can and *will* hold their own.

The Horton Kirby Paper Works, South Darenth, Kent.

IT is unnecessary to inflict the reader with the dry details of the ancient history of paper-making, which are doubtless known to every schoolboy. It will suffice to note that the first paper-mill in Great Britain was started in the sixteenth century near Dartford, and was worked by Sir John Spellman. It is near, if not actually on, the same site that the Horton Kirby Paper Works now stand. They may, therefore, fairly lay claim to the proud distinction of being the earliest paper-mill in the country. Caxton claimed the precedence for a mill worked by a maker named Tate, but this is a moot point and one for antiquaries to decide.

The Horton Kirby Paper Works are remarkably well situated, being only eighteen miles from London. This situation has recently been still further improved by the opening of a railway direct to Gravesend,—a distance of five miles,—by which the Works are placed in easy communication with the sea and foreign ports. They stand in the lovely valley of the Darenth, which takes its name from the River Darenth flowing through it, one of the most celebrated trout streams in the south of England. Unlike nearly all streams that pass through factories, this one is permitted to flow past the Works as pure as it rises at its source. The proprietors have established a system so perfect for recovering and utilising the waste products, that fine trout may be seen sporting in the river under the very nose of the industrious monster on the banks. Here, surely, is a state of things that would delight the heart of Ruskin.

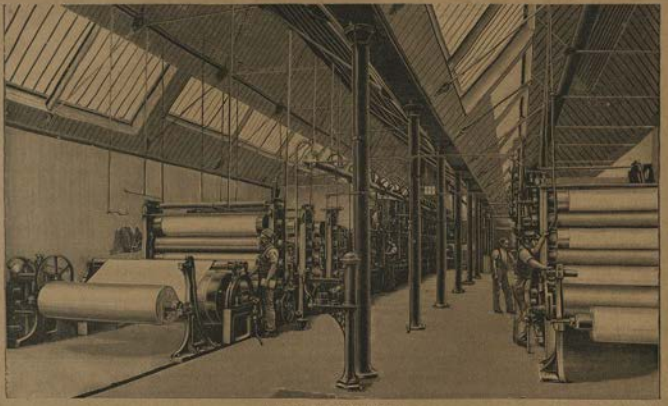
It is popularly supposed that, whereas formerly paper was made of rags, this material has been entirely superseded by Esparto grass. It is, doubtless, true that this material has been largely adopted by paper-makers, yielding, perhaps, too readily to the demand for a cheaper and inferior article, instead of endeavouring to maintain the high quality of paper on which books of the past were printed. It is curious to observe how tenaciously this factory clings to its old traditions, and continues to give rags a foremost place in the material used. That this is a necessity may be gathered from the fact that here is still made the genuine old-fashioned rag-paper that books of a bygone age were printed on, and to which this country owes its reputation for both excellent paper and printing. That rags can still be used so largely by these makers in their papers is due, no doubt, to the general excellence of the machinery and the skilful manner in which the Works have been planned. One department may be said to actually deliver the materials in process of manufacture to the next department almost entirely without manual labour. The cost of manufacture being reduced to a minimum, necessity for extreme economy in the quality of raw material does not exist.

This is an age of cheapness, and, consequently, of inferior workmanship, and it is refreshing to find one of the largest factories in Great Britain maintaining the excellence of the quality which made its reputation, and still holding the foremost place, in spite of the fierce strife, of what may be characterised as reckless competition. We do not propose to give a detailed description of all the various processes through which the raw material passes. We propose merely to touch on the most noteworthy features in the

manufacture as carried on in these Works. In pursuance of this we cannot omit to refer to the magnificent

VIEW OF WORKS. [*From a direct photograph.*

steam-boiler house, which contains twelve Lancashire boilers and four large Economisers. The whole arrangement



VIEW OF MACHINE HOUSE. [*From a direct photograph.*

has been designed and recently carried out by an eminent engineer. In consequence of the admirable steam-boiler arrangement, together with the large and powerful condensing steam-engines of the most modern and

approved type, an economy in fuel has been effected that places the factory at a very great advantage. The extensive and lofty rag-sorting house also calls for special comment. Many female hands are employed here dusting, sorting, and cutting the fine, soft, white cotton rags for the plate, woodcut, and super-calendered dry printing-papers, and also strong Russian rags for the tougher class of tub-sized writing and account book papers made in the Works.

One of the most striking processes in a paper-factory is the bleaching of the esparto. The transformation of the yellow grass to a brilliant white is at once beautiful and remarkable. Purity of colour has always been a characteristic in the papers made here, and one which has not a little puzzled competitors. We have not much hesitation in divulging the secret, since it cannot be made use of. This brilliance of colour, is really owing to the unusual excellence of the spring water, which rises to the surface, in unlimited quantities, from two deep artesian wells,—one being 300 ft., and the other 400 ft., deep. Unlike the peat-coloured water, so prejudicial to manufacturing in the Scotch and North of England streams, this water is perfectly clear and colourless. It is described by Dr. Frankland, the well-known water analyst, as of most excellent quality and purity.

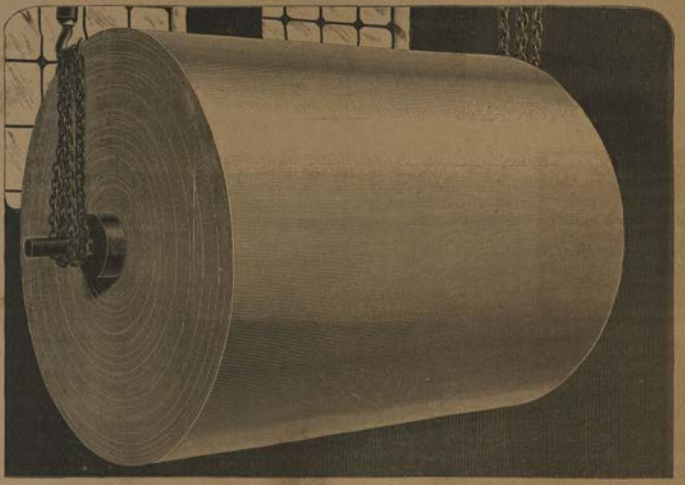
VIEW OF FINISHING HOUSE. *(From a direct photograph.*

We shall now pass on to the machine-houses, where the pulp is actually transformed into paper. Our illustration shows that portion where two large machines are to be seen running side by side. As an example of the high state of efficiency in which this machinery is kept, we may mention the enormous reel of *Graphic* paper, illustrated on the next page, which this Firm succeeded in running off their largest machine. This reel, 9½ miles long, was exhibited at the Adelaide Exhibition, and caused the profoundest astonishment.

The machine on which this was made is 160 feet long and 92 inches wide. Although a very high surface is obtained on the machines themselves, there are many papers required with such a highly-polished surface (notably such paper as the roll illustrated overleaf) that the paper has to be taken to another department to have the necessary surface produced. Highly-calendered dry printing-papers have long been one of the specialties of this Firm, and the *Graphic* and *Illustrated London News* and the *British and Colonial Printer and Stationer* are among the papers of this description that have been made in these Works regularly for many years. As specimens of the finest rag papers that are not printed dry, we may cite the *Art Journal* and the *Portfolio*, both papers having been made in these Works for years, as well as a great number of unique works of art, such as "Keramic Art in Japan," a class of work obtainable only by a few on account of its costliness. Paper of finer quality than this it is scarcely possible to imagine and impossible to obtain.

Our third illustration shows a portion of the Finishing Department, where every sheet of paper made is inspected by female sorters before it is put up into reams for sending out.

The great area of this department precluded the possibility of photographing more than a small section of it, but the necessity for the great space required may be gathered when we state that the mills are capable of producing 120 tons of paper weekly. Over 400 hands are employed in these Works, and it is worthy of note that they have never been out of work or on short time for a single day, but, on the contrary, the proprietors have always found it difficult to keep pace with the demands of their numerous customers. The papers can be obtained in all parts of the world, including large colonial towns such as Sydney and Melbourne; and the convenience of customers is consulted by the courteous attention of travellers, to whom they can express their numerous wants verbally, instead of being put to the trouble and expense of correspondence by telegrams



ROLL OF "GRAPHIC" PAPER 9½ MILES LONG. *[From a direct photograph.*

or letters. It may not be out of place here to note how travellers have advanced with the times; and surely they are fairly entitled to some tribute to their excellent business capabilities, their courtesy, tact, and perseverance, by which they have facilitated business as much for the buyer as the seller.

In concluding this article it may be interesting to allude to the kindly feeling existing between employers and employés. In connexion with these mills, the proprietors have established a sick benefit society, co-operative stores, and an institute where good literature is obtainable, and games of many kinds can be played. All these have proved an inestimable benefit to the workers, and are thoroughly appreciated by them. It is the belief of the proprietors that success in any business is only to be reached in the highest sense by obtaining the hearty co-operation of the workers themselves, and getting them to take an intelligent interest in their work. Having attained this desideratum, they feel as confident of holding their own in the great battle of competition as "those English" of whom Napoleon I. complained, who never knew when they were beaten.

Messrs. Spalding & Hodge, London.

FEW of the great English commercial houses are of mushroom growth. Here and there, it is true, we see industrial undertakings of exceeding magnitude, spring up, as it were, in a single night. But the most of these prove as evanescent as the fungus they typify, and, after a short season of delusive splendour, they vanish away. It is only by years of painstaking toil, of honourable dealing, and of liberal enterprise, that a great and staple business can be built up. Those princely houses that dominate, and, in many cases, almost control, the industries they deal with, are not the work of a few years or of even a generation. Established in the days of England's rising commerce, they have grown and extended with it. Firmly fixed in the confidence of their vast connexions, they become less of the nature of private trading concerns than public institutions, in the stability of which every one has a personal interest. Among the great houses which, as a whole, have contributed so largely to the commercial greatness of England, none appears more worthy of descriptive mention in the present connexion than the house of Messrs. Spalding & Hodge, who, as Paper-makers and Stationers, have been established upwards of a hundred years in this—one of the oldest and most important of all industries.

In the year 1780, Thomas Spalding founded the business that still bears his name, and which has risen through the course of a century to its present magnitude. The source of the great organisation that now extends its fibres throughout every part of the globe, was necessarily a small one. Apart from the circumstances of the period, limited production, defective carriage, and the like, the excessive duty on paper and advertisements, proved a most formidable barrier to the extension of the trade. In spite of these restrictions, however, the sagacity and enterprise exercised by the guiders of this Firm were so successful that, on the repeal of the Paper Duty, the Government of that day was obliged to pay them a sum of no less than £16,000 as "drawback" on the stock of paper in their possession. The removal of this obnoxious impost was followed by a tremendous increase in the trade, and Messrs. Spalding & Hodge, who foresaw and appreciated the importance of the measure, spared no effort to keep pace with the impetus it created. Still maintaining that reputation for liberal and honourable dealing they had always enjoyed, they are now without a rival in the extent and importance of their transactions. They still preserve as their chief establishment the premises in which their first sheet of paper was sold a hundred years ago. But at various periods branch houses have been founded by them in England and abroad and these have done much in the extension of their trade in other countries.

In the warehouses at Drury Lane there are stocked upwards of 1,500 tons of paper. This is, unquestionably, by far the largest quantity of paper amassed together in the world. Although the finer sorts predominate, every class and quality is represented. Stacked in apparently never-ending avenues, this vast array of material gives a most imposing idea of the extent and importance of the knowledge-creating industry. Ponderous double iron doors protect the different warehouses from the spread of fire, while the innumerable

gas-jets extending through the narrow corridors are carefully enveloped in wire netting. Light is scant in these massive buildings, for the strongest sun cannot penetrate the immense tiers of paper that lie overhead and around. On the ground floor a never-ceasing bustle denotes the life that lies within these gloomy warehouses. The sample-rooms and offices are here, and, although fitted with every modern improvement, still retain their old-fashioned appearance. Hanging on the dusky walls are various relics of former days; old invoices, grimy and discoloured, ancient watermarks and etchings connected with the early history of the Firm—all carefully framed and preserved as business heirlooms to be handed down in turn to succeeding generations.

Their large and varied stock enables Messrs. Spalding & Hodge to execute at once almost every order sent them, without waiting, as it is requisite for smaller houses to do, upon the mills to manufacture. But the stock at Drury Lane, vast as it is, does not by any means exhaust their resources. At their almost palatial mills in Kent, the finest of modern machinery is constantly occupied in replenishing the warehouses. A handsome building in Cannon Street fulfils the duties of their City Office, and from this department the Indian and Colonial business is controlled. The depôt at Paris, in the Avenue Victoria, has now been carried on for several years, for the supply of high-class printing and writing papers in France. The Rush Mills at Northampton produce the best hand-made papers.

Great as is the quantity of paper produced at their own mills, however, this forms but a small proportion of that which Messrs. Spalding & Hodge supply. The great emporium at Drury Lane purchases extensively from a large number of paper-mills, not only in England, but abroad, distributing their products over every quarter of the globe. The quiet counting-house, where, a century ago, when paper was made, not by the mile, but by the sheet, Thomas Spalding wrote out his modest invoices, is now the daily scene of the most extensive transactions. Their operations extend to every part of the world. Splendid establishments in Melbourne and Sydney control their Australasian trade; in Bombay and Calcutta trusted agents supply the increasing demand for paper which civilisation is creating among the Indian people. The following list sums up the Establishments of the Firm, and is a practical testimony in itself to the vast organisation possessed by Messrs. Spalding & Hodge for supplying with their specialty the markets of the world. CHIEF OFFICE AND WAREHOUSES: 145–147, Drury Lane, 8–11, Great Wild Street, London. EXPORT OFFICE: 34, Cannon Street; MILLS: Horton Kirby Paper Works, South Darenth, Kent; and Rush Mills, Northampton; FRANCE: 20, Avenue Victoria, Paris; AUSTRALASIA: Bank Place, Melbourne; O'Connell Street, Sydney.

We may say, in summarising, that the paper trade has never been retrograde in its character, but since its earliest history has always been extending and developing. And this great industry will still rise and expand as knowledge and education increase, for it is one of the very few that depend for their existence upon the highest attributes of mankind. "While the peaceful arts flourish," to use the words of Lord Brougham in his noble eulogy, "so will the Art of Paper-making, for it is the very root and nourisher of them all."

Messrs. Venables, Tyler, & Son, London.

UNLIKE most other articles of manufacture, Paper may claim to be an indispensable adjunct to almost every branch of Commerce and Industry. Some years ago, Mr. Gladstone stated in Parliament that Paper was largely used in about seventy different trades, but we shall probably be not exceeding the bounds of truth when we say that the above-given number of industries in which Paper is largely employed might at least be doubled. It is the more gratifying to realise to what a degree of perfection our Paper Trade has attained, when the heavy odds against which it has had to contend are borne in mind. As early as the year 1581 we read of English Paper-makers being undersold by foreign rivals, commenting upon which fact, William Stafford, a writer of the period, says, to use his own quaint phraseology, while, however, modernising the spelling: "I would either have the foreign paper stayed from coming in, or so burthened with Custom, that by that time it came hither our men might afford their paper better cheap than strangers might do theirs, the Customs considered." Thus History repeats itself, and the grievance of the time of Queen Elizabeth is as keenly felt in the days of Queen Victoria. About a century later, Fuller, the Church historian, complains of the want of encouragement extended to the Paper industry, and, seeing that large sums of English money were spent for the foreign product, he thinks that the more general use of "our home-spun paper might be found beneficial." That these complaints were well founded, appears from the fact that the value of Paper made in this country about the year 1700 amounted to only £28,000. Even worse times were, however, in store, for it was in the year 1712, and in the very month in which we are now celebrating Her Majesty's Jubilee, that an Excise duty was imposed on Paper ranging from eighteen-pence to fourpence per ream, according to the size and quality of the Paper, and for a century and a half this impost remained in force.

Since that period the Paper Industry has undergone quite a revolution, both as regards the raw materials employed and the manufacturing processes themselves, and yet there is still in our midst a Firm connected with the Paper Trade which can trace back its origin in direct descent to those long-ago days of Queen Anne, and forming thus a connecting-link between the early days of Paper-making and the present time of wholesale manufacture. The business we refer to is that of Messrs. Venables, Tyler, & Son, which was established in the early part of the eighteenth century by William Venables, who set up at Cookham as a maker of hand-made packing Papers. From that time down to the present, during a period of more than 170 years, his descendants have ever been connected with the manufacture of Paper, and the Cookham Mill is still owned by the Venables family. By degrees the business was extended, and in course of time other mills were added, as, for instance, the Claptons, Glory, and Woking Mills. At a more recent date new Paper-mills were built at Taplow, and these, too, are still worked by descendants of the original William Venables.

Until the beginning of the present century the business had been thus carried on exclusively in the

Berkshire district. Foreseeing, however, the great scope for such an enterprise in the metropolis, one of the grandsons of the founder, also named William Venables, established himself in London, in 1806, as a Wholesale Paper Merchant and Stationer, in Queenhithe, Thames Street. He took into partnership Mr. William Tyler and Mr. A. Wilson, and traded under the Firm name of Venables, Wilson, & Tyler. The Firm soon acquired a high standing, and, as showing the great esteem in which Mr. Venables was held by his fellow-citizens, we may mention that he was elected Sheriff in 1821, and four years later filled the office of Lord Mayor in a manner that gained him universal esteem. He also worthily represented the City of London in Parliament for many years.

The present partners of the Firm are Mr. T. C. Venables and Mr. George R. Tyler. Both are men of great practical experience, who by the exercise of care and attention, aided by skill and ingenuity, have built up a business which enjoys deservedly a foremost reputation. Mr. Tyler, who has been a member of the Court of Common Council, was, in March last, elected Alderman of the Queenhithe Ward, and will thus in due turn fill the office of Lord Mayor of London, as did the original founder of the business. The quality of the Firm's various Papers is excellent, alike for body, colour, and texture, and the product is thus equally pleasing to the eye and the touch. No wonder, therefore, that their Papers are in great favour with printers as well as stationers, while there is also a considerable demand for them in Colonial markets.

Quite in keeping with the old-established nature of the business is its location in a thoroughfare which, under the name of Edred's-hithe, or harbour, is believed to have existed even in the time of the Saxons. However that may be, we have an unbroken record of the place for about eight centuries, and as long ago as the year 1220 it was known by its present name—*Ripa Reginæ*, the Queen's Wharf, or Hithe. It has been conjectured that the name originated from the fact that the revenues derived from the Hithe constituted part of the pin-money of Henry's queen, Eleanor of Provence.

The warehouses of Messrs. Venables, Tyler, & Son constitute one of the very few surviving landmarks in a district full of historical associations. There is about each of the various rooms an old-world appearance that is extremely interesting. To the antiquary and the lover of the picturesque there is a charm not easily equalled about this place, with its carved mantelpieces, ornamented ceilings, massive doors, and heavy rafters. All the rooms are stocked with quantities of Printing, Writing, Drawing, and other Papers, of which the Firm make a specialty. As the visitor passes from floor to floor, he is greatly impressed with the vast piles he sees around him of that most useful and indispensable article, Paper, the universal value of which has been most happily epitomised by a German writer when he describes it as "a repertory of all the arts and sciences, a minister of all governments, a broker in all trades and commerce, a second memory of the human mind, and the stable pillar of an immortal name!"

The business we have here described deservedly finds a place in this record of England's commercial greatness, since Messrs. Venables, Tyler, & Son have ever made it their object in all their transactions to maintain that character for fair dealing and high integrity which has helped to secure for British Paper a reputation and undisputed supremacy in all the markets of the world.

The house and the spacious adjoining warehouses cover more than half an acre of ground, and all the loading and unloading is carried on in the large central courtyard under cover.

The Patent Borax Company, Birmingham.

IF it were only intended as a witticism or not, there is much sound wisdom in the saying of a great French scholar, that the words "Vanity of vanities, all is vanity" do not embody the meaning of the wisest of kings; that the quotation, *Vanitas, vanitatum, omnia vanitas,* is the result of a mistake made by an early copyist, and that what Solomon did say was *Sanitas, Sanitatum, omnia Sanitas.* However that may be, it is recognised in our own day that the question of public health out-distances all others in its far-reaching effect, and the knowledge of sanitary science is gradually extending to ever-widening circles. Increased attention is happily being paid to the agents which influence, for better or for worse, the average bodily vigour, mental energy, healthiness, and length of life of the community. As compared with fifty years ago, great strides of progress have been made, by insuring better drainage, freer ventilation, purer water, and a wider diffusion of the comforts of life. Acknowledging this much, it must be added that a great deal, nevertheless, still remains to be done, and more especially in the matter of personal cleanliness, for as Mr. Simon, the late Medical Officer to the Privy Council, stated some years ago, "uncleanliness is the deadliest of our present removable causes of disease."

Having regard to the importance of this subject, it will be acknowledged that the value of any agency cannot be over-estimated by which cleanliness is promoted, both in the person and in home surroundings. Such a medium has been introduced within the last few years in the form of Prepared Californian Borax, manufactured by the Patent Borax Company, of 10 to 15, New Market Street, Birmingham. This preparation is one of unequalled merit, and it is no easy matter to do justice to its sanitary and purifying properties. It may be well if, before describing the above specialty, we say a few words concerning the element Boron. Its highest and most valuable property lies in the fact that, when properly combined in the form of the several compounds, to which we shall more fully allude by-and-by, it acts as the purest and most effective antiseptic known. A natural combination of boron is obtained from the great Boron Lake in California, discovered in 1874 by Mr. Arthur Robottom. Being a man of shrewd intelligence, Mr. Robottom soon realised the importance and value of his discovery, and bought from the State of California this Borate Valley, and subsequently arranged with the Patent Borax Company to introduce to the public the incomparable gift thus accidentally discovered. This then is the simple story of how one of Nature's greatest boons was made available to the community.

When the Patent Borax Company was started they had thus the difficult problem before them of familiarising the public with a product which, while of the utmost value on sanitary grounds and highly conducive to promoting health, was to all intents and purposes a novelty, and as such scarcely regarded with favour. They, however, set to work with a will, determined to leave nothing untried that could possibly be made the means of

opening people's eyes to the truly wonder-working virtues of borax in its purified and concentrated form as supplied by the Company. The remarkable success which has attended their efforts is perhaps best attested by the fact that there are probably very few homes in this country in which these borax preparations are not now in daily requisition, either for toilet, culinary, or sanitary purposes. They are placed upon the market, moreover, at a remarkably low price, and are attainable of all shopkeepers who deal in articles of domestic utility, and the sale per annum amounts to many hundreds of millions of packets.

Passing on, however, from these general remarks we would refer to some of the distinguishing attributes of a few of the Company's specialties, and foremost among these is the prepared Concentrated Californian Borax.

WORKS OF THE PATENT BORAX COMPANY, BIRMINGHAM.

This preparation is a marvellous purifier and arrester of decay, and while perfectly harmless to the life of man, of animals, and of plants, it is a potent destroyer of all vegetable impurities and of the living germs and atoms which exist in impurity. It is done up in various sized packets containing from one pound downwards. Every packet has a label of which the accompanying sketch shows a facsimile, and bearing the signature of the discoverer, Arthur Robottom. The Company have been compelled to take this and other precautions in order to insure that the public shall not be defrauded, as, since the introduction of the above Prepared Borax, repeated attempts have been made to foist upon buyers inferior and adulterated articles, as well as so-called Loose Borax. Some of these substitutes are worse than useless, and are palmed off by a few unprincipled shopkeepers for the sake of extra and illegitimate profit.

How fully justified is the designation of this preparation as "The Household Treasure" will be obvious when we mention that it acts at the same time as a marvellous purifier, a water softener, a dirt expeller, a taint remover, a food preserver, and an arrester of decay. Moreover it is pure, agreeable, and perfectly safe in use; while preserving all healthy substances, it destroys all infectious germs, and does not corrode. This Concentrated Borax is invaluable for purifying, softening, and preserving water; and is equally beneficial and efficacious for toilet, laundry, cooking, and other personal and domestic purposes. It is without doubt the purest antiseptic known, preventing decay, and preserving fresh and sweet for a prolonged—we had almost said an indefinite—time, every kind of animal food to which it is applied. As supplied by the makers in packets it is, moreover, always ready for use, and can be carried about whilst travelling, keeping always pure and sweet. In reference to its innocuous nature we need but mention that for many years past, medical men as well as nurses have invariably administered borax mixed with honey, as an unfailing remedy for babies suffering from thrush. Equally beneficial and soothing are its effects when applied to irritations and eruptions of the skin.

Hard water, as is well-known, is one of the discomforts of town life, and especially so in London. This hardness interferes greatly with the comfort of personal ablution, as well as with its use for domestic purposes. Here again the wonder-working power of the Prepared Concentrated Borax steps in, for a tablespoonful thrown into the water-jug overnight transforms the irritating hard water into a pleasant mollifying element. For purifying water for drinking and cooking purposes this Concentrated Borax is equally valuable, and it is a most extraordinary phenomenon that water containing one and a half per cent. of this preparation will keep pure and sweet for many years. We were greatly interested in seeing and tasting at the offices of the Company several samples of water which had been thus treated more than seven years ago; they were perfectly clear, fresh, and limpid, without any trace of infusoriæ or animalculæ.

A special preparation is made for the toilet under the name of Boraxaline. It has a pleasant fragrance, and is especially adapted for personal use. It will soften water for the bath or other ablutions, and is the means of making the skin soft, delicate, and white. If used as a tooth powder it will prevent decay, purify the teeth, and make the breath sweet. Equally excellent for the toilet are the Patent Borax Glycerine Transparent and Borax "Beauty" Soap Tablets. A cognate article is the Borax Extract of Soap; for cleaning, washing, scouring, disinfecting, and purifying clothes, floors, wood, &c., there is probably nothing to equal it.

Chloride of lime and carbolic acid have during recent years been held in great favour for disarming animal and vegetable exhalations. Both are poisonous, and although this is less the case as regards creosote, tar resin, &c., still these too labour under the serious defect that they injure most of the domestic articles with which they are brought in contact, besides which their odour is strong and objectionable. Not only so, but they are also deceptive in their action, covering only, as it were, by their stronger smell the poisonous exhalations which they are intended to counteract. Boron Sanitary Powder, on the other hand, is an antiseptic which at once stops decomposition. It arrests decay by separating the elements that produce foul gases, and by thus removing the cause, the foul smells disappear. It can be used with safety and advantage in living rooms and bedrooms as well as kitchens, scullieries, domestic offices; for the disinfection of drains, stables, and wherever foul smells arise. It is also a most effective preventative of crickets, beetles and other vermin. More extraordinary still is the fact that the Boron Sanitary Powder has no smell itself, and is quite harmless if taken in mistake by adults, children, or domestic animals; and does not injure carpets, furniture, clothing, &c. In case of death, by the employment of this Boron Sanitary Powder the body may be kept if necessary for weeks or even months in its natural state, with expressions on the features fully preserved, and without decomposition or danger to the living.

Although we have written at some length upon the subject, we are conscious that thrice the space at our disposal would be required to do justice to the sanitary virtues and inherent merits of the various borax preparations brought within the reach of all classes by the Patent Borax Company. By the introduction of their several specialties they have conferred a great boon upon mankind, and have created an important industry. Their large Works are fitted up with many kinds of labour-saving appliances, and give remunerative employment to a large number of girls, women, and men.

Commodious store-rooms for concentrated, rare, and refined borax soap, and the various other ingredients used, are attached to the Works. Other shops are set apart for the manufacture of the thousands of wood boxes annually used in sending out the various articles. Yet another department is devoted to the storage of the several borax preparations already alluded to. The export trade is largely cultivated, and enormous quantities are sold abroad.

Taking all the various departments together, viz., the laboratories, mills, packing and labelling rooms, box-making and advertising departments, counting-house, &c., the Company now give employment to about 500 persons. As regards the advertising department, it is worth recalling that in one room here there are stored immense quantities of labels, of which there are no less than one hundred varieties. These and the wrappers, showcards, posters, handbills, illustrated books of receipts, &c., are ordered by a million at a time, some even to the number of 5,000,000. Down to the present time no less than 75,000,000 printed sheets and books, as mentioned above, have been distributed to make these preparations familiar to the public, and the amount already spent for this purpose exceeds £55,000! As further illustrating the ability, energy, and originality that have been brought to bear upon this new industry, we may state that the Company have down to the present date secured the following patents and copyrights:—2 British patents; 48 English and foreign copyrights; 48 British trade-marks; and 38 Foreign trade-marks, and others are in progress of registration.

Summarising some of the points upon which we have touched above, it but remains to add that the Concentrated Californian Borax Preparations are applicable to every age, from the day of birth to that of death, and even beyond if we may say so, for if borax were used in public cemeteries, the natural circle of transmutation of "dust to dust" would be completed, and the economy of nature conserved, without any

THREE OF THE MOST IMPORTANT TRADE-MARKS BY WHICH PATENT BORAX PREPARATIONS ARE KNOWN.

poisonous gases being evolved in our burial-grounds. Borax in the form in which it is prepared at these Works can with impunity be applied—if we may be pardoned the tautology—to the tenderest skin of the tenderest part of the tenderest baby, and it will help to preserve the most delicate and most minutely organised tissues of the human system. The alchemists of yore used to ascribe marvellous virtues to the Philosopher's Stone, which was believed to transmute base into precious metals. Even greater and more beneficent virtue than this may, however, be claimed for the borax preparations under notice. They transform what is vile and foul into the harmless and innocuous; the diseased and decaying into the wholesome and sound; the unhealthy and pestilential into the salubrious and uninfectious; and may thus claim to be the true *Elixir Vitæ*. Indeed their universal use would help to bring about in a minor degree the realisation of that tempting picture of Dr. Richardson's Hygieopolis—that City of Health, so glowingly depicted some few years ago.

Sir Robert Peel once observed that nothing could conduce more to sobriety and to the encouragement of domestic habits among the lower classes than a pride in cleanliness and the means of commanding it. Regarded from that point of view the Patent Borax Company have proved themselves the greatest benefactors of our times, for the managers—gentlemen rarely gifted as chemists and scientists—with an enthusiasm worthy of the cause they have at heart, have thrown their whole energy into the enterprise, and in waging successful war against dirt, decay, and disease, have conferred substantial benefits upon this and future generations. For, let it be remembered, to quote the words of one of our greatest living medical men, that as the great rivers spring from little sources which a child can leap over, so "the rivers of Health must spring from the hearths of the people," while Patent Borax and its preparations have come in as marvellous helpers, adapted as well for the homes of the humblest cottager as for the palace of Her Majesty the Queen.

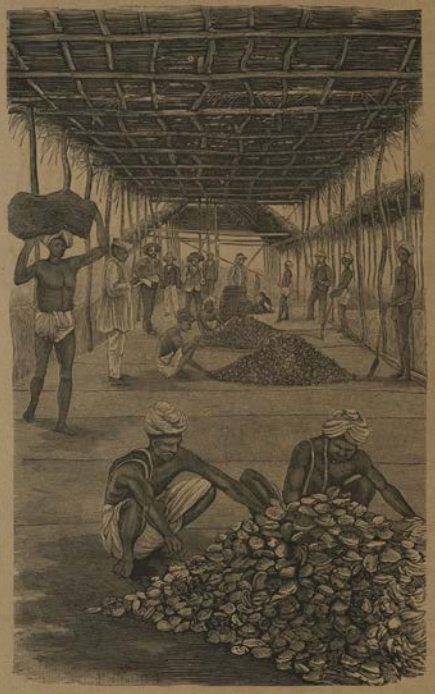
GEMS.

Mr. Edwin W. Streeter, London.

EDWIN W. STREETER, of Bond Street, London, and Buxted, Sussex, the subject of this notice, is one of our leading commercial men, and one who may justly be ranked among "the business men of our time." Three considerations entitle him to this distinction: first, on account of the high position he occupies as one of our largest and most successful pearl and diamond merchants and dealers in precious stones, a position which he has earned by his recognised intimate knowledge of the subject; second, as being one of our boldest pioneers in all legitimate fields of new enterprise in any way connected with his own particular department; and third, because he occupies no mean place in the world of letters; in other words, because he is the successful merchant, the fearless speculator, and the well-known author.

Descended on the mother's side from the Foljambs, of Derbyshire, he was born in Kent in 1833; came to London at the age of thirteen, and, having completed his education and selected his future career, without much assistance from outside, we find him in 1855, at just over the age of twenty-one, occupying his first responsible position in life, viz., that of buyer to the then famous firm of Messrs. Howell & James. With them, as well as with another firm of well-known Bond Street jewellers, under whom he filled important trust-worthy positions, he acquired not only such a knowledge of the gem trade, but those strict habits of business which may be said to have laid the foundation of his future prosperous career. At the age of twenty-five he entered the business of Mr. Harry Emanuel, of Hanover Square, originally the Firm of Emanuel Brothers, of Bevis Marks, which was established in the reign of King George III. Aided by the push and enterprise of young Streeter, the business was so increased that it was soon afterwards transferred to more eligible premises in 18, New Bond Street. Mr. Harry Emanuel having retired in 1873, the business became incorporated with that of Messrs. Hancock & Co., Limited, and since that date the entire business has been conducted by Mr. Streeter; the high position and world-wide reputation which this house has achieved has been due to his indomitable perseverance and well-known integrity. Having attained this prominent position, one would have thought it would require all the capacity of one man to efficiently supervise and conduct the management of such an establishment, in order to keep pace with the keen competition of the times and the growing requirements of the trade, but Mr. Streeter had energy enough and to spare. Accordingly, we find him at a very early period in his career taking up the question of legal regulations for the standard of gold, and advocating the principle that all manufactured gold should be of a recognised standard value; that 18-carat should be the standard, and that all articles containing less than 12-carat gold should be sold as metal. To prove the sincerity of his conviction on that point he insisted on manufacturing and persevered in offering, at all risks to his own trade, only 18-carat gold. He argued that the gold thus transferred retains its marked current value, no matter how long it may have been used in the shape of articles

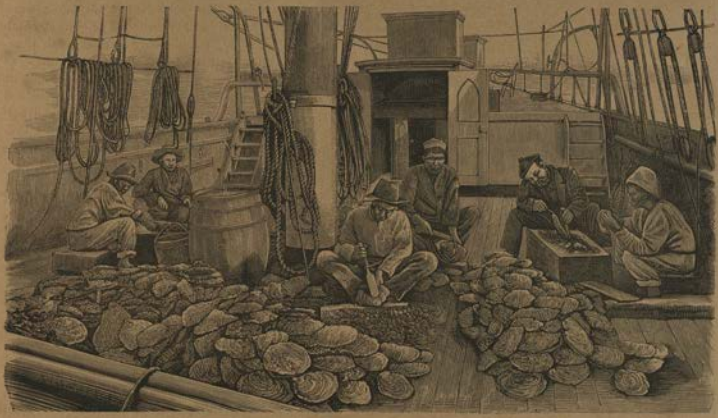
of ornament or luxury, and that the adoption of this principle into practice would tend to raise the tone of the jeweller's trade and be a decided gain to the public. After fourteen years' experience he has found no reason to change his opinion. Again, we find that shortly after the "Diamond Fever" at the Cape broke out Mr. Streeter was one of the first to equip an expedition to the diamond fields, in charge of Professor Tobcn, who, had he followed faithfully Mr. Streeter's instructions—the correctness and true policy of which have since been amply verified in the experience of others—the speculation might have turned out much more successful. After this, in addition to mining operations for sapphires, cat's-eyes, and other gems, carried on by him in Ceylon, Mr. Streeter successfully competed in the pearl fisheries of that island, many interesting details of which he has published in his latest work on "Pearls and Pearling Life," from which we make the following extract (with illustration):—"In 1880 the usual notices of sale were circulated by the Government throughout Ceylon and India, and created considerable excitement amongst the natives. For many years the fisheries had yielded such poor results that pearls were becoming exceedingly scarce, as indeed they still are. Previously to this fishery, no European had ever ventured upon this speculation of buying oysters on a large scale, although for many years, as each successive fishery had been conducted by the Government, a few Europeans, such as the military officers and merchants of Ceylon, had speculated in a small number of oysters to the extent of £2 or £3, just as they might venture on a Derby sweepstake. But no regular organised washing of pearl oysters had ever been attempted by any European. The whole business had for generations been monopolised by the native merchants from the bazaars of India and Ceylon. The report of the survey being encouraging, and the sample of pearls found in the preliminary diving having been above the average, both in yield and in quality, Mr. Streeter determined upon speculating, and accordingly his agent was commissioned in Colombo to attend the public auctions and bid for the whole of the yield of the fisheries. But the Ceylon Government refused to entertain any single private offer or tender, and determined to put the oysters up in lots in the usual way, as per sketch. The fisheries were held off the N.W. coast of Ceylon, at a district called Silavatoirai or Silvatura, a most inaccessible place, the only means of transport being by common fishing canoes, or by chartering a special steamer. The fleet consisted of two divisions, alternately working the banks, which were situated at a distance of about ten to fifteen miles from the shore. Mr. Streeter's agent, who had been in Ceylon some years, arranged for



AUCTION OF PEARL OYSTERS IN CEYLON.

native brokers to purchase at market rates as many lots as possible, and the prices varied each day according to the report of successful finding of pearls. In rough numbers a quarter of a million of oysters were purchased. As the distance from Silavatoirai to Colombo was not only very great, but bare of all means of transport, a fleet of boats was kept constantly employed in sailing between the fishery station and Colombo, until all the oysters purchased had been brought to the capital.

"The preparation of a place to receive the oysters, and to carry on the washing and search for pearls proved a most difficult undertaking. The first journey of the small fleet landed about 12,000 oysters, each boat being capable of carrying 1,000. The sacks containing the oysters were sealed at Silavatoirai, whilst the oysters were alive, and were conveyed to a large building on the beach at Colombo. Preparations were at once made for immediate washing, but, unfortunately, the difficult passage from Silavatoirai to Colombo, with contrary winds, had so delayed the arrival of the boats that by the time they had reached the capital the sacks of oysters emitted a most unpleasant odour. The Superintendent of Police, Captain Hansard, upon



OPENING OYSTER-SHELLS COLLECTED BY THE PEARLING FLEET, AND SEARCHING FOR THE PEARLS ON BOARD MR. STREETER'S SCHOONER, THE "SEFE PAS-SAIR."

receiving a complaint from the residents in the neighbourhood, at once communicated with the agent, and threatened confiscation of the whole cargo if not immediately removed. On receipt of this communication from the police, the agent immediately prepared four large tin-lined cases, in which were packed a sample of 10,000 oysters. These were to be shipped at once to England, in order to ascertain by personal knowledge the most satisfactory method of securing the pearls. It was intended that the washing should take place at Buxted, on the river Ouse under the Crowborough Hills, in Sussex, where plenty of running water could be obtained for the purpose but this could not be, so they were opened in Ceylon, and very few pearls obtained; but, later on, Mr. Streeter's agent bought some £700 or £800 worth of pearls that had been pilfered from his own shells. But though there were several overlookers besides Mr. Streeter's agent, they managed to secrete quite half the pearls, so the business of bringing these oysters, and all the trouble of removing them up country (see "Pearl and Pearling Life"), resulted in some few pounds profit, which was handed to the agent, for all the trouble and the bad smells he had to put up with."

Although not in the order of time, we may here mention Mr. Streeter's famous venture,—his pearl and

pearl-shell expedition to the north-west coasts of Australia, and in the Sooloo Seas,—which now comprises a small fleet of two large vessels (see illustration) and twenty boats, supplied with diving-dresses by Messrs. Henke & Co., made on the newest and most approved principles.

Of Mr. Streeter's fleet and of all the pearling vessels on the north-west coast, the finest and most complete is the *Sree Pas-Sair* ("the belle of Pas-Sair," a district in Borneo), a brigantine of 112 tons, bought and equipped by the late Mr. E. C. Chippindall, R.N., at the expense of Mr. Streeter. She has large and comfortable accommodation, having a high poop. She carries eight dingies, each 14 feet 6 inches in length six being carried on davits and two on deck, and she draws 7 feet 6 inches aft, and carries sufficient fresh water to last eighty men for three months.

Few have any idea of the many dangers and difficulties experienced by pearlers, and by those engaged in the trade of collecting pearls and pearl-shell. The troubles of the pearl-seekers are not confined, however, to encounters with semi-savages. For instance, the houses which Mr. Streeter's men had erected in the Sooloo Archipelago were wantonly pillaged and wrecked in March, 1884, by the Spaniards, when at war with the late Sultan of Sooloo. Not only was the property destroyed, but the town of Lamenusa was entirely burned, and many of the population were taken captive and sold into slavery. Another of the dangers was shown in a paragraph of the *Times* of November 2:—

"MURDER OF PEARL-DIVERS.—MELBOURNE, *Nov.* 1.—Captain Craig, of the ketch *Emily*, and a party of pearl-divers, of whom two were Englishmen and six Malays, have been murdered at Johannes Island, near New Guinea."

In September, 1883, the *Sree Pas-Sair* left Singapore in charge of Mr. Chippindall. The pearling vessel proceeded eastwards, prospecting all the unsurveyed coast up to Port Darwin, but found nothing until that port was reached. On the first day, at Port Darwin, "shell" was struck close to the town, to the great excitement of all the inhabitants, the good news being telegraphed all over Australia. As soon as shell began to get scarce in the shallow water, Mr. Chippindall decided to prospect; but the easterly monsoon setting in, he stretched across to the Aru Islands, on his way to New Guinea. Seven days were spent at Dobbo, in Aru, and here a strange incident happened worth mentioning. On attempting to heave up the anchor it was found to be foul. On sending a man down to report (in 12½ fathoms) it was discovered that the anchor had dropped into a small hole in a rock, standing solitary on a smooth bottom, and that the flukes were firmly fixed below the overhanging edges. The following device was resorted to in order to clear the anchor:—A man having gone down, and made fast a small line to the fluke of the anchor in the hole, all chain was veered out to ensure the safety of the ship; four candles of dynamite were bound together with a fuse inserted, and attached to a thimble on the line. The line was then held quite taut and vertical, the fuse lit, and the charge dropped, the line being held until the charge was felt to have reached the bottom. The dingy then paddled away from the spot, and the charge was exploded. The result was that the anchor came up with a broken fluke, and the rock was shattered to pieces.

During the vessels' absence from Port Darwin, large numbers of boats had arrived from Torres Straits with diving-dresses, and the harbour presented a most lively appearance. They did very well for a short time, but the South Australian Government, besides enforcing heavy licence fees, offered no inducement to get the coast prospected; and, at the present time, there is not a single pearling boat left in the waters of the northern territory. The dream of wealth has vanished, and the golden goose is asleep, if not dead. Swimming divers are gradually dying out, and each boat of the fleet carries one diving-dress and twenty divers. All these men are signed under the shipping articles, and are, therefore, under complete control. The sister vessel to the *Sree Pas-Sair* the *Telephone*, has to devote the greater part of her time in fetching fresh water for the crew, as a great scarcity exists on the north-west coast of Australia.

Again, we find Mr. Streeter, associated with a few other gentlemen, embarking on a fresh enterprise; this time to the River Tibagy, in Brazil, where diamonds and gold have been discovered lying together in the soil of the old dried-up streams of this river. The prospects of this undertaking are eminently satisfactory. And now, in this present Jubilee year, we find Mr. Streeter's name associated with what may become one of the most gigantic undertakings of modern times. The annexation of Upper Burmah is now an accomplished fact, and the concession of the Ruby Mines of that country to Mr. Streeter is of such vast importance and public interest that it has attracted attention in all quarters, and has been discussed in the press and debated in the House of Commons. His second son, Mr. George Skelton Streeter, accompanied the troops on their march from Mandalay to these famous mines, and has been superintending operations at the mines of Moguk, Kyat-Pen

and others, since the occupation of them on January 1 of this year; and so successful has been his mission that all the necessary preliminary arrangements for entering upon the work are now satisfactorily concluded. (For full particulars of these mines, see an article by Mr. G. S. Streeter in *Murray's Magazine* for May.)

The illustration represents one of the most remarkable coloured diamonds known, being of a beautiful orange tint; the only other decided large coloured stone is the "Hope Blue," which is one-third the size, but, no doubt, at one time much larger (see "Great Diamonds of the World," "The French Blue," page 253). The Orange diamond was found in the Orange River, South Africa, in 1885, and weighed in the rough 269 carats. Being of an exceptionally fine shape, it was cut in London, being reduced in weight to 116 carats. Mr. Coster, the well-known diamond-cutter, of Amsterdam, and who recut the Koh-i-nur, at the Crown jewellers in the Haymarket, London, pronounces it one of the finest specimens of diamond-cutting that has ever come under his notice. This stone weighs ten carats heavier than the Koh-i-nur, and is three-sixteenths larger in circumference than the "Pitt" or "Regent," which weighs 137 carats. The French Republic, after several years consultation, have decided to sell the whole of the Crown jewels in May this year, except the "Pitt" diamond, which is to be placed in a museum, still remaining the property of the nation.

It was originally the intention to raise a sufficient sum, to be subscribed by the maidens of England, to purchase the "Orange" diamond from its present holders, and present it to Her Majesty the Queen on her Jubilee, but owing to delay in some of the arrangements, and to the hint thrown out that all available funds should be devoted to the interests of the Imperial Institute, the undertaking was abandoned. The sixteen fine white diamonds that surround the orange-coloured brilliant weigh over thirty-seven carats, or over 2¼ carats each stone.

THE FAR-FAMED "ORANGE DIAMOND."

As an author, Mr. Streeter has been before the public since 1876, when his first work was published at the request of the Board of Trade. It was entitled,—

(1) "Gold," and in it, among other important matter, Mr. Streeter adduces strong arguments in favour of a standard of purity for gold, and recommends a uniform standard of eighteen carats. As a proof of its acceptance with the public, we may mention that it has gone through twenty editions. His next publication was

(2) "Precious Stones and Gems," which is a practical work on the nature, properties, and value of precious stones, rather than a scientific treatise, and has admirably fulfilled the intention of the author. This, too, has passed through no less than four editions, and the author is now looked upon as an authority on all matters connected with precious stones and gems. The next work

(3) "The Condition of Nations," was published by Mr. Streeter in conjunction with the late Dr. Brewer, M.P., a work regarding which the *Athenæum* says, "It is a veritable treasury of statistical knowledge, and its historical retrospects and explanatory notes endow it with a permanent value." Next appeared

(4) "The Great Diamonds of the World," which presents a biography, so to speak, of every diamond of over thirty carats, celebrated for its size or beauty, or otherwise interesting from its associations. The second edition of this is just exhausted. Towards the close of last year (1886) Mr. Streeter's latest work issued from the press, entitled,

(5) "Pearls and Pearling Life," which, as we are informed in the preface, is the only book in the English language entirely devoted to the history of pearls. The first edition is just out of print.

We may add, that Mr. Edwin W. Streeter is a Fellow of the Royal Geographical Society, a Member of the Anthropological Institute, a Fellow of the Society of Arts, and a Fellow of the Royal Agricultural Society. He has also received a Gold Medal for Merit in Art and Science from the King of Wurtemberg, attached to the Ribbon of the Royal Order of Frederick, in Sept., 1878; and a Gold Medal for Merit in Art and Science from H.M. the King of the Belgians, May, 1880

Mr. James Yates, Birmingham.

SCARCELY any business, not actually obsolete, has probably been more changed by fashion than that of the pewterer. Plates and dishes, which at one time formed the staple production, are now rarely asked for except for foreign markets. The tendency of the trade during recent times has been to cater for the requirements of refreshment-bars and hotels, and the better taste and greater elaboration which have been brought to bear upon the fitting up of these have not remained without their influence upon the pewterer's trade; and drinking-cups, beer-engines, and similar goods are the specialties now mostly in demand.

In Birmingham the manufacture of articles made of pewter was introduced in the early part of the present century, and the earliest general business of this kind established there is still in successful working. The Works of Mr. James Yates, situate at 39 & 40, Coleshill Street, Birmingham, were founded by Mr. John Yates, and, in the year 1826, they passed into the hands of his son James. The latter took into partnership two practical men, named respectively Birch and Spooner, the business being carried on in their joint names. At the death of Mr. Spooner the Firm was altered to Yates & Birch, and, since the death of the latter, it has been carried on by Mr. James Yates in his own name. Coleshill Street, it is worth adding, is a thoroughfare of truly historical interest in connexion with the Birmingham trades, for in it was erected, in the year 1740, the first local brass house.

When originally built the Works stood at some distance from the street, but, in order to keep pace with the constant growth of the business, repeated additions have been made to the buildings, which form now an oblong structure, affording ample accommodation for the various manufacturing processes. The business is divided into two distinct branches, one for the production of brass goods, and the other for pewter work. The former comprises casting, turning, screwing, and boring-shops for the manufacture of beer-engines, lift and force-pumps, beer and water goods, and plumber's brass-foundry.

The Pewter department includes mixing, casting, drawing, and turning shops for the manufacture of wine, beer, and spirit measures, tankards, inkstands, syringes, plates and dishes, &c. Machinery of the most recent type is everywhere brought into requisition, and the motive power for these is supplied by one of Tangye's horizontal engines. Apropos of this, we may mention that as a connecting link between the past and present, there is still preserved in one of the workshops an old fly-wheel, 10 ft. in diameter, and fitted with leaden tyres, which in the days prior to the introduction of steam was used for supplying the motive power to the turning-lathes, &c., the wheel itself being at that time turned by strong labourers.

Among Mr. Yates's specialties are lever beer-engines made after Stocker's and other patents, and one of these is represented in the accompanying illustration. From personal examination of this class of goods we can attest their substantial workmanship and excellent finish, which remark applies equally to the cabinet-maker's and the pewterer's work, the former of which branches is also carried on at the Works. It is worth

recording in this connexion that all fittings here produced are tested before leaving the warehouse, while great pains are taken at every stage of the manufacture to insure the highest quality of the materials employed; and to this fact is doubtless due the high reputation which Mr. Yates's productions enjoy in Colonial as well as home markets.

A large variety of beer and wine, high-pressure, range, and racking-cocks form a cognate branch of manufacture, and in the production of these much skill and knowledge are exercised. Tankards and drinking-cups are made in many varieties, and a favourite pattern of one of these is shown in the accompanying "cut."

Apart from pewter work, similar fittings to those already mentioned are made in Mandal silver. This metal is specially adapted for the purpose in question by reason of its resisting the action of acids, and not affecting the taste of the liquors, while at the same time it keeps its bright colour permanently.

On the occasion of our visit to the Works we saw also many other distinct types of goods in process of manufacture, notably a variety of teapot known as the Dutch pattern. Of this thousands are annually made for export markets. Pewter inkstands, again, seem to have fully regained their former popularity, and it is difficult to give the reader an idea of the number which we saw in course of manufacture, all of them being part of a Colonial Government contract which has been entrusted to Mr. Yates. It speaks, indeed, volumes for the quality and substantial character of the work done that many such important contracts have been placed with him at different times; and the creditable manner in which they have been carried out has materially contributed to insure for his productions a well-established demand in the world's markets. The woodwork and other fittings made for the Colonies are so contrived as to remain unaffected by every possible change of climate and temperature.

Among other classes of goods manufactured at these Works are pewter syringes, jugs, funnels, plates and dishes, Communion services, and pretty well the whole range of plumber's brass-foundry, and a thoroughly-representative selection of these several articles is being now shown at the Adelaide Jubilee Exhibition.

Worthy of mention is the fact that while the business under notice has been presided over by successive generations of the Yates family,—there has similarly one generation of workmen followed another in the Firm's employ, and the present staff of employés includes some of the grandsons of those who worked originally under the founder of the Works. This speaks well for the mutual relationship between both parties, and further insures the survival and continued application of much valuable experience and the practice of many well-tried manipulative processes, inherited from father to son.

Messrs. Perken, Son, & Rayment, London.

IT may be broadly stated that the arts and industries of Great Britain have, in spite of periods of depression, the cause of which it is not now our duty to trace, advanced by leaps and bounds during the fifty years covered by the happy reign of Her Majesty Queen Victoria. These various industries we point to with national pride as the source of Britain's greatness. But there is a certain art and industry which stands alone in one important respect. It has not only advanced and been greatly developed during the period referred to, but it has actually originated during the Queen's reign. We speak of that beautiful art, of such world-wide fame, which is called Photography.

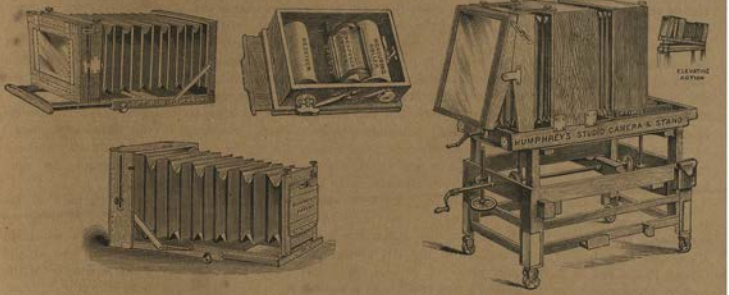
Some people might, perhaps, object to the word "industry" being applied to such a thing as picture-making, but a moment's reflection will cause them to change their opinion. Although, primarily, photography is an art, and one which is extending its applications almost every day, it is at the same time a most important industry, and an industry upon which many thousands of our fellow-creatures, who know not how to take a photograph, are dependent for their daily bread. The production of a modern photograph causes, from first to last, a number of manufactures to be set in busy motion. If we take the chemical part of the art alone, we find that various chemical salts which are now identified with it are used almost exclusively for photographic purposes, and produced by the ton. Some of these salts were in former days of so little importance that they were produced in small quantities, and were simply of interest to the experimental chemist. We might name some which, costing so much an ounce, are now produced, so great has the demand for them extended, for the same price per cwt. Then, again, special kinds of papers are required for photography, and the production of such papers forms the sole occupation of many large mills, to which are attached thousands of busy workers. So, again, in the matter of cameras, for which armies of cabinet-makers are required, metal-workers for making the necessary adjuncts to those cameras, lens-makers, and others, whose name is legion. It may thus be shown that photography has now become something more than a mere art: it represents many important industrial enterprises.

A glance at the history of this art may not be considered out of place. We have to go back as far as the sixteenth century to find the first link in the chain which it has taken three centuries to bring to perfection. This was the invention by Baptista Porta, the Neapolitan scientist, of the camera-obscura, which, in a modified form, became an appendage in the last century of country houses, and can still be seen at the Crystal Palace and at many other places of popular amusement. This was undoubtedly the forerunner of the modern photographic camera. Many artists used it as a method by which they could more correctly delineate natural objects, and it was due to a French scene-painter that the camera was first made to yield an image no longer evanescent but permanent. This artist, who was scene-painter at one of the Paris theatres, was the famous Daguerre. Daguerre's first pictures were taken on silvered plates of metal, and, although beautiful,

they had a disadvantage, in that they could not be multiplied,—that is to say, the picture taken in the camera was the picture handed to the person whose photograph was taken. Another name, to which much credit must be given in tracing this history of photography, is that of Fox Talbot, who, at the time that

Daguerre was working in France, was busy in England following up the same line of research; but whereas Daguerre's pictures were produced on metal plates, Fox Talbot worked upon paper as a basis for his pictures.

In 1851 the art of photography really received its first great impetus since the time of Daguerre, in the introduction of the wet collodion process, by which it became possible to produce in the camera what is now



well known as a negative image, from which an unlimited number of copies upon paper or other material could be furnished. From this time photography became a great power in the land, and thousands of workers began to obtain their livelihood from it, both directly and indirectly, as we have already pointed out. It was

to a certain extent, taken up by amateur workers; but these were limited in number, for the collodion process, although furnishing results which could not be excelled, had drawbacks in the shape of unpleasant chemicals, which were inconvenient to one who was not obliged to depend upon the art for his living. But six years back a revolution was worked in the art by the introduction of what is known as dry-plate photography, which has almost altogether superseded the wet collodion process in use in 1851. By this process the various operations required in taking a photograph are made so easy and simple that it is not an exaggeration to say that an intelligent child can gain a very fair knowledge of the art in an extraordinarily short period. This change in the aspect of affairs has caused the amateur of bygone days to be multiplied almost indefinitely; and, we may even go so far as to say that, in the present day, in this country alone, there are dozens of amateur photographers to every professional worker.

The introduction of dry-plate photography has led to a marvellous development of the art and the various industries dependent upon it, for there is a steady and increasing demand for all kinds of apparatus. With this improvement in the chemical method of producing a photograph has come a necessary revolution in the form of the mechanical appliances used. A sketch is appended of the camera and lens with which our forefathers were content to work, and the only apparatus, in fact, which it was in their power to obtain. Let us contrast this with modern appliances, and although we may see from the mere outward appearance of the two instruments that they are entirely different, there is still more difference between the powers which they possess. Whereas, in the time of Daguerre and his contemporaries, the obtaining of a photographic image was a matter of thirty seconds to one minute, by modern lenses a picture can be secured in a fraction of a second so small as to be difficult of calculation. Mr. Muybridge, of California, exhibits photographs which he has taken in the 2,000th part of a second, and we can point to pictures in this country fulfilling every condition of artistic excellence which have been taken in the 120th part of a second. Such things are only possible by lenses and mechanical appliances of a very perfect character. One of these is in the form of a book, easily carried under the arm, but is in reality a camera capable of producing perfect pictures at the will of the owner. This is the latest form of "Detective Camera," and is shown in the annexed illustrations.

Once more let us compare the camera with which the first workers had to produce their pictures with the modern camera. It will be seen that the old instrument simply consisted of one box fitting into another, the sliding action of the two being utilised to secure the correct focus. In the modern camera the weighty box is done away with, for the body of the instrument is of leather, and is of bellows form, which shuts up into a space so small that pocket cameras are now common commercial articles; but, beyond this improvement, the modern camera is fitted with self-adjusting screws and other appliances that were never thought of or considered necessary in the days of old, but which modern requirements have rendered indispensable. In striking contrast to the handy pocket camera we may mention that some for studio use are now not uncommonly made thirty-six inches square, and for map-making much larger, and are of considerable weight.

The Firm of Messrs. Perken, Son, & Rayment (under the old and well-known title of Lejeune & Perken) was one of the first to supply photographic lenses and apparatus; and, it may be truly said that, in the present day, they have attained, by the excellent quality and the compact design of their cameras and lenses, a world-wide fame. It is, therefore, only consistent that their names should appear in this ALBUM, which is commemorative of the Jubilee of Her Majesty the Queen, as the premier manufacturers of photographic apparatus in this country. Their most recent apparatus is figured in the engravings which illustrate this notice of their work.

LIBRARY OF THE BOMBAY BRANCH OF THE

Messrs. John Brinsmead & Sons, London.

TIMOTHEUS, by the power of harmony, "raised a mortal to the skies,"—so, at least, Dryden informs us. If any man of the present day can adopt the quaint conceit of imagining himself possessed of the mantle of Timotheus, that man must assuredly be the subject of our brief biography. Born in the near neighbourhood of Bideford, some nine months before the thunder of Waterloo proclaimed the downfall of a tyrant, we find the founder of the Firm of John Brinsmead & Sons in 1836 had selected his path in life, and begun business in the metropolis at an age when many young men are still hesitating in their choice of a profession. The pianoforte of the period was crude to a degree. True, it had superseded the harpsichords and spinets of a previous generation; but, although the musical world admitted that a great gulf had been bridged over, and that the piano spelt very decided progress, one man felt that it was but in a primary state of evolution. Filled with this absorbing idea, John Brinsmead henceforth devoted himself to the perfection of the instrument which was ever afterwards to be honourably associated with his name, and the manner in which he acquitted himself of his task is well worthy of attentive consideration. His mind first grasped the fact that to bear the continuous tension to which all stringed instruments are subjected, a greater strength of framework should be accorded than manufacturers had hitherto deemed necessary. Wood, which had up to that time represented the *ne plus ultra* of strength, was displaced by metal, and this change was the stepping-stone to still further departures, whose outcome, after years of patient study, is the remarkable patent tone-sustaining piano for which the Firm have attained their world-renowned celebrity. It must not, however, be supposed that the half-century which has elapsed since Mr. Brinsmead first began prosecuting his investigations has set the final seal of perfection on pianoforte production. The hale, hearty old gentleman of seventy-two summers who meets one with a cheery welcome in his Wigmore Street warehouse is still as active as ever in following up his theory of development, and one cannot help agreeing with the pessimist philosopher who talks of the decadence of English bone and sinew to-day, as one watches this bluff representative of advanced manufacturing science bending over magnificent specimens of his own specialties, adjusting the niceties of chords, and "voicing" each one,—for it should be mentioned that half the secret of Mr. Brinsmead's success lies in the fact that he is *facile princeps* a master in that peculiar accomplishment of "voicing" without due attention to which the tone of no piano would be able to defy criticism.

Many years ago the Brinsmead family owned land in Devon, Somerset, and Middlesex, the portion situated in the latter county being sold early in the present century. Strangely enough, when increase of business compelled the Firm to open up extensive works in the near neighbourhood of London, the ground found most suitable for building and storage purposes was either the actual site or adjacent to that which was once owned by a previous generation of the Brinsmeads, and thus the title-deeds, at a tremendously-enhanced

valuation, again reverted to the descendants of the original possessors. Here, in Kentish Town, an immense number of employés are busily engaged, and an inspection of the various workshops in which the instruments are rapidly prepared for home and exportation is a curious and instructive study. One cannot help remarking that the tendency for square wood-work has at length overcome the modern notion that nothing but rotundity pleased the eye, and the cunningly-moulded pianoforte leg and truss, on mathematically square lines, is a decided advance, so far as artistic effect is concerned. Messrs. Brinsmead were among the first to note that the coming craze was for the square Mediæval style, and with true business enterprise seized on it. The quality of the highly-seasoned mahogany, walnut, and other woods used in the manufacture is tested at Kentish Town, and the tests to which these important adjuncts of a sound instrument are submitted are of a most crucial and exacting character. Of special statistical interest in this connexion is the estimate that a completed piano is turned out of their vast factory every working hour throughout the year, except in

MR. JOHN BRINSMEAD.

the slack season. It does not require any extraordinary knowledge to be aware that atmospheric conditions greatly influence the average life of the pianoforte, and therefore remarkable care has to be exercised in preparing those instruments whose destination lies within the tropical zone, or, indeed, any country contiguous to it. Mr. Brinsmead has not neglected this difficult question, and the testimonials received from India, the Cape, Brazil, and similar *locales*, prove how thoroughly he has mastered climatic considerations.

For the last quarter of a century Mr. Brinsmead in his own proper person has been the recipient of an ever-increasing shower of distinctions. Few, if any, tradesmen of the century can point to such an imposing array. Setting aside the gold medals and diplomas awarded him at various times, which alone would fill a page, we may select for mention the fact that his services in the cause of music have gained for him the Cross of the Legion of Honour, the Royal Portuguese Villa Vicoza Order of Knighthood, the Academical Honours of the Royal Academy of St. Cecilia of Rome, of the Académie Nationale de France, and of the Brussels Conservatoire; while from every composer and singer of note in Europe, including such names as Rubinstein, Gounod, Sims Reeves, Foli, Stainer, De Kontski, and the Abbé Liszt, the most flattering personal encomiums have been sent to Wigmore Street. All this must be highly gratifying to the *amour propre*

of one whose sole aim in life has been to elevate and improve his much-loved instrument; and the hearty commendation of the late Duke of Albany, who used a "Brinsmead" at Claremont, may also be pronounced a happy memory. A fact little known is that one of the Firm's best pianos is kept at the Hôtel Bristol for the especial use of the Prince and Princess of Wales when staying in the French capital, though, for the

matter of that, scarcely a public building can be mentioned in any large European city where the name of this great English Firm does not figure conspicuously. The Brinsmead Shield, which is annually competed for at Wimbledon under conditions similar to the Mullins trophy, shows the man who has caused the English-made pianos to be the envy of the world in another light, to be patriotic; and, although we have delicately refrained from inquiry into his political proclivities, one may feel pretty sure that, being patriotic, he is "on the side of the angels."

Messrs. D. F. Tayler & Co., Limited, Birmingham.

ADAM SMITH, the author of the "Wealth of Nations," writing a century ago, gives us a very curious picture of the manufacture of pins as carried on in his day. "A workman not educated to this business," he says, "could scarce perhaps, with his utmost industry, make one pin in a day, and certainly could not make twenty. But in the way in which this business is now carried on, not only the whole work is a peculiar trade, but it is divided into a number of branches, of which the greater part are likewise peculiar trades. One man draws out the wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the head; to make the head requires two or three distinct operations; to put it on is a peculiar business; to whiten the pins is another; it is even a trade by itself to put them into the paper; and the important business of making a pin is, in this manner, divided into about eighteen distinct operations, which in some manufactories are all performed by distinct hands." This description may well raise a smile among those who are familiar with the manufacturing process as now carried on, for the trade has been quite revolutionised within the last half-century by the introduction of machinery.

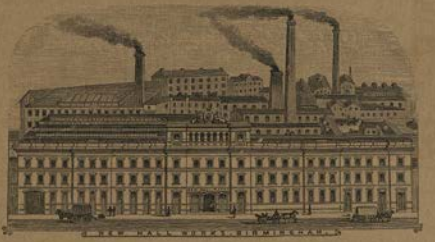
About seventy years ago the first attempt was made to produce pins by machinery. It proved, however, unsuccessful, and soon afterwards, in 1824, a patent was taken out by an American, named L. W. Wright, for a machine which during the revolution of a single wheel was to produce a perfect pin. This machine, which was worked at a factory in Lambeth, was, however, as yet far from perfect, and the Company owning it failed before the new pins had been brought into the market. The machinery was then transferred to Stroud, in Gloucestershire, into which county the trade had been originally introduced two centuries earlier, and here the manufacture was conducted by Messrs. D. F. Tayler & Co. Many thousands of pounds had to be spent in experiments with the object of making the machine perfect. Subsequently, Messrs. Tayler removed to Birmingham, and here they have ever since carried on the manufacture, their Firm being, we believe, the oldest established in this particular line of business. At their extensive factory, the New Hall Works, in George Street, Parade, Birmingham (of which building an illustration is annexed), the whole of the various processes of pin manufacture can be seen in operation, as well as the making of safety and hair pins, hooks-and-eyes, &c.

Unlike most other firms engaged in the manufacture of pins and needles, Messrs. Tayler & Co. make their own wire, and also supply large quantities thereof to other manufacturers. Commencing our description of the process of pin-making with this initial stage, we may mention that, with few exceptions, all pins are formed of brass wire. The brass, after having been cast in the form of ingots, is rolled down to the desired thickness. The strips of metal thus produced are next divided by the aid of slitting rolls. These latter are set in motion by power, and on the rolled strip being presented to them, it is dragged in, and slit

longitudinally into as many strands of equal breadth as there are revolving discs or cutters. The strands thus produced are, of course, square, and in order to convert them into round wire they are drawn through a succession of draw-plates, or holes of various sizes, diminishing in diameter. The drawing process tends to harden the wire, and it has consequently during the course of reduction to be repeatedly annealed. The amount of wire used in the manufacture of pins is something prodigious, and the quantity thus employed in Birmingham alone represents annually a value of about £100,000! Let it be remembered that this is merely the cost of the raw material employed in the production of pins. A large proportion of this yearly consumption is not only made at Messrs. Tayler's rolling-mills, but is moreover converted into pins at their factory.

This Firm, it is worth placing upon record, were the first to introduce, more than fifty years ago, the now universally-used solid-headed pins, and since then many important improvements have been effected by them, both in the manufactured article and in the machinery employed. The pin-making machines, as seen in operation at the New Hall Works, are marvels of human ingenuity and skill. They are of small dimensions, measuring only twenty-eight inches in length, nineteen inches in width, and seventeen inches in height.

The wire itself is mounted on a reel, from which it is fed into the machine. The first operation is the straightening of the wire as it is drawn in. As soon as this is done the wire is seized by a pair of dies, and by an automatic arrangement a small punch moves, gives three sharp taps at one end of the wire, and thus the head of the pin is complete. The piece of wire thus headed is next cut off to the desired length, and passes then down a sliding groove into a tray, which is provided with a slit at the bottom.



This slit allows the body of the pin to pass through, but not the head, and it hangs thus suspended by the head through the slit. In this position the pin is made to travel from one side to the other, and, while doing so, a revolving steel roller placed underneath is busy in making the necessary point at the end. This done, the pin is complete so far as its formation is concerned, and it is then dropped into a tray provided for the purpose. All these processes are performed quite automatically, without the intervention of human labour, and the production goes on at a rate of speed which it is difficult for the eye to follow.

The finishing process still remains in order to make the article fit for commerce. Having been first freed from all grease and dirt, the pins are next "whitened." For this purpose a copper vessel is used, in which the pins are boiled in water, together with grains of metallic tin and a certain quantity of bi-tartrate of potash. When the boiling has continued for about two hours, the pins are taken out. They are then washed, dried, and polished, which latter is done by placing them in barrels and mixing them with bran or sawdust, and then well shaking the barrels. The bran is afterwards readily removed by a kind of winnowing machine.

The above is a fair outline of the process of pin manufacture, and the only variation in connexion with mourning pins is that they are first "blued" on a hot plate or in a muffle, and then dipped in black varnish, so as to give them either a bright or dead black finish as may be desired. The procedure in the fabrication of hair-pins, safety-pins, and other varieties, differs, of course, materially from the above, but need not be described here.

Being now ready for "sticking" or papering, a highly ingenious apparatus is brought into requisition. The

pins are placed in a hopper, with which is connected a steel plate having longitudinal slits, which correspond with the number of pins to be put in a row. The pins are worked into these slits by the agency of a special tool. A long strip of paper is then put on the machine, and crimps are raised upon each one. After this the pins are driven through the slits in the steel plate, and pressed through the crimps into the paper until the sheet is filled. This work of sticking also proceeds at a marvellous rate of speed, and with an accuracy that is truly astonishing.

There is little need to dwell upon the quality of Messrs. Tayler & Co.'s manufactures. During the sixty or more years which their business has been in existence, they have established a reputation which is not excelled by any other house, and the high standard of goods bearing either of the four trade-marks here shown is recognised in all parts of the world; indeed, the name of the Firm has come to be regarded as a guarantee of perfect workmanship and superior finish. It has ever been the consistent policy of the Firm to supply only articles of standard merit, and it is thus that they have created a universal demand for their pins, needles, and other specialties. That English goods of this description are superior to all others is well known, and Messrs. Tayler & Co. may justly claim to have greatly contributed to secure for British pins and needles such a reputation abroad that they have become indispensable in almost every home on the Continent as well as in the Colonies.

That even in the doing-up of such matter-of-fact articles as pins there is room for the display of taste, has been shown by Messrs. Tayler & Co., who have introduced a Patent Pyramid Pin Cushion, as shown in the accompanying sketch. As will be seen, it consists of a small round box daintily finished, and filled with pins perpendicularly placed, and so arranged that the projecting heads form a glittering pyramid. This prettily-contrived Pin Cushion has deservedly proved a great success in both home and export markets. The same remark holds good of the Firm's Pin Book. This is adapted equally for the work-box, the toilet-table, or the pocket. The pins, in three assorted sizes, are arranged in twelve rows, there being altogether 528 in a book, and any one of them can be readily withdrawn for use. These Pin Books, no less than the Pin Cushions, are ingenious contrivances, tastefully got up, and of practical usefulness.

PATENT PYRAMID PIN CUSHION.

Messrs. Tayler & Co.'s specialties, to which we have here drawn attention, are patronised by the highest in the land, and the Firm enjoy the great distinction of being Pin Makers by Special Appointment to Her Majesty the Queen. At the different International Exhibitions where their goods have been exhibited, they have invariably carried off Prize Medals. It is impossible for an outsider to form an estimate of the number of pins produced at the New Hall Works, but it must be something enormous. It has, indeed, been computed that the production of this country amounts to 50,000,000 pins per day, and that three-fourths of this total are made in Birmingham. Seeing that Messrs. Tayler are among the largest of local makers, it follows that a very great proportion of the above-given total—presuming it to be approximately correct—is manufactured in their extensive establishment. As further bearing upon this subject, we may state that each of the large number of machines here employed turns out about 200 pins a minute!

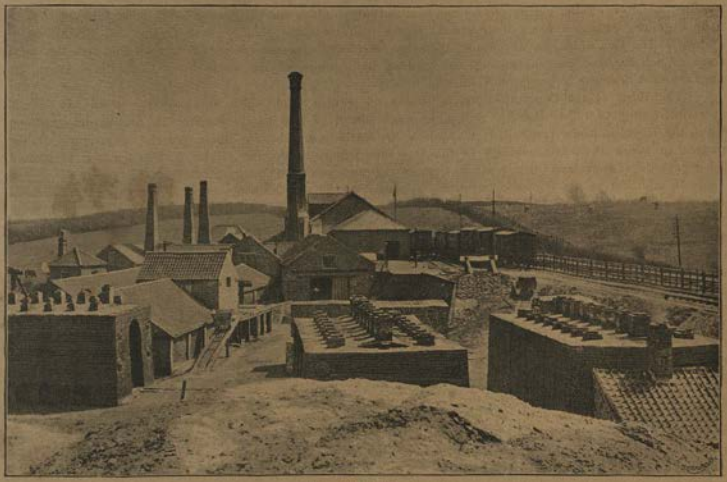
From the foregoing it will be seen that, although pins are almost universally regarded as emblems of insignificance, still the process of making them, as here carried on, has been developed into a prominent branch of British industry. What we have said above will also prove to the reader that subtle brains and lissom fingers, much thought, time, and energy, were needed to bring the manufacture to its present state of perfection. That the wearisome eighteen processes of Adam Smith's days have been reduced to one or two in our own time, and that the manufactured article, unlike that of yore, is characterised by great strength, neat appearance, and superior finish,—all this is largely due to the Firm who have in this article engaged our attention.

The Vale of Belvoir and Newark Plaster Company, Newark.

FEW localities are more interesting than those in which this famous Firm of plaster manufacturers carry on their extensive business. The Vale of Belvoir embraces a fine stretch of pastoral landscape, the fringe of picturesque hills which overlooks it being crowned by the princely residence of the Duke of Rutland. In this lovely vale stretching to the borders of three counties many attractive spots exist to win the admiration of the visitor; and some of them—Bottesford, for instance, with its fine church full of monuments to members of noble families—are largely resorted to in the summer months. Within sight of this pleasant vale is the ancient borough of Newark-on-Trent, and while those who delight in the charms of rusticity and the pure air of open country will find much to please them in the Vale of Belvoir, people with a fondness for historic localities will see irresistible attractions in the old town of Newark, once dignified by the title of "the Key of the North." Standing on the great north road in a central and commanding position, and possessing in its castle a powerful fortress, Newark was naturally regarded as a stronghold of no ordinary value. It would occupy too much space to enter into historical detail, but we may mention two or three leading events which have served to give it a permanent place in the records of our country. It was at Newark Castle, now a stately ruin, that King John died after the loss of his baggage in the Wash, and it was round the same walls which sheltered the dying monarch that the turbulent tide of battle ebbed and flowed during the great Civil Wars. In that memorable period of disturbance and bloodshed the town sustained three vigorous sieges, but it never yielded an inch. It held out stubbornly to the last in defence of the Royal cause, to which, in response to the personal appeal of the King, it had willingly given its loyal allegiance. It was through Newark that Charles passed on his way to Nottingham to raise the standard of war; it was to Newark that he returned on several occasions when his prospects had grown darker; and it was a short distance from the old castle, in the fields at Kelham, that he became a prisoner in the Scotch camp when all hope of a successful resistance was at an end. Coming to modern times, we may mention that it was the town where Byron's first poems were printed; where Wilde and Thesiger, two Lord Chancellors in embryo, fought a stubborn political battle; and where Mr. Gladstone made his first appearance as a politician, having been returned as member for the borough for the first thirteen years of his Parliamentary life.

With such associations as these Newark and the Vale of Belvoir may be fairly said to possess special claims to notice, but the geological formation of the district is in many respects no less interesting than its historical records. In parts of the vale between Newark and Belvoir and in the Beacon Hill are thick beds of the finest gypsum to be found in any part of the world. Gypsum is one of the varieties of native sulphate of lime, its structure is fibrous and earthy, and the recognition of its value dates back to very ancient days. As a material for casting and taking impressions it was known to the Greeks, and the writings of Theophrastus and other authors refer to its utilisation for this purpose, and for the ornamentation of buildings. Gypsum is met

with in the clays, but its great repository is in the rock commonly called New Red Sandstone. There are various kinds to be found, but the quarries at Newark, Bowbridge, and the Vale of Belvoir have long enjoyed a special reputation. In Tomlinson's "Cyclopædia of Useful Arts," a high authority, the writer says the *finest* gypsum is required in making casts; he adds: "The best part of the crystalline gypsum rocks of Newark is well adapted for that purpose." The fact that they possessed, close to their doors, an unusually valuable commodity, supplied by the favouring hand of Nature, was early known to the Newark people, and plaster-making is one of the most ancient trades in the town. Before the discovery of steam the gypsum was reduced to powder by flails, a wearisome process, but modern invention has supplied facilities for the output of abundant quantities, so that the making of plaster has become one of the leading, thriving, and most valuable industries of the district. The Vale of Belvoir and Newark Plaster Company, to meet the demand which the increasing fame of their products is causing from all parts of the world, have had to enlarge their operations from



THE ORSTON WORKS.

time to time, until their Works and mineral properties now comprise no less than 150 acres. The three extensive pits which the Company possess are situate at Orston, near Belvoir, Bowbridge, and Beacon Hill, Newark; and under the energetic and successful management of Mr. R. P. Almond, who is largely interested in the prosperity of the concern, give constant employment to a large body of work-people, thus proving a source of great and increasing benefit to this part of the Midlands. To supply the power requisite to keep all the machinery in motion seven boilers are required, and ten engines are continually running.

We will notice first the pits nearest that princely residence, Belvoir Castle. The Orston Pit, illustrated above, was selected by the Geologists' Association of London to visit at their annual excursion in 1876, and it is one of the largest and most complete mines of the kind. Its extreme depth is about 70 feet. Several kinds of stone are found on the property, but the best and whitest qualities are generally deepest from the top. After the gypsum has been liberated from its bed by blasting, the men break it up with wedges, and it is wheeled on barrows to the foot of an inclined plane, whence it is drawn to the surface by trams and

wire-ropes worked by steam power. The pit is kept dry by means of powerful pumps, capable of raising 750 gallons of water minute. When the outer blue coating of the plaster has been chipped off, the stone is treated in various ways, according to the purpose for which it is required. That made into *terra alba* is passed through a crusher, which splits it into small pieces, and taken thence by elevators into a mill, where it is ground to powder. In the manufacture of the popular Plaster of Paris the gypsum is first calcined by burning for some hours in kilns, and is then crushed between revolving stones, known as edgerunners.

The Orston Pit is a constant scene of activity, and the same may be said of the Bowbridge Works, near Newark. Here a centre of industry has sprung up, thanks to the indomitable energy and enterprise of Mr. Almond, and as that gentleman, who has purchased a large area of land in this neighbourhood, looks forward to the allotment of it for building purposes, we shall not be surprised to see a little village here in a few years' time. To provide the requisite accommodation for the large traffic which the mine occasions commodious sidings have been put in, under the authority of a special Act of Parliament, and it is worthy of mention, as showing the extent of railway accommodation which the Company needs, that a mile and a half of railway sidings connect their several Works with the Great Northern and London and North-Western systems. In Bowbridge, as at Orston, there are enormous deposits of the finest gypsum, and the same scene of activity, the constant raising and crushing by steam-power, the same description of hand labour by numbers of workmen, is going on from day to day.

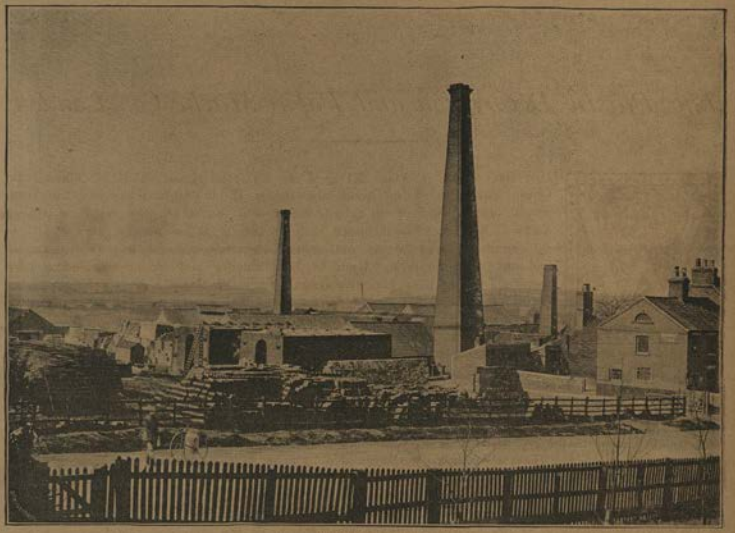
The third of the Company's pits is situate on Beacon Hill, which overlooks the town of Newark. It is interesting to reflect that the hill which once served to hold on its summit the beacon fires, and on which the Royalist leader marshalled his troops in battle array, has in these peaceful days supplied the material to adorn the public buildings of this busy nineteenth century, and yielded to the demands of modern life thousands of tons of the best material from its rich and inexhaustible supply.

In addition to the immense quantities of plaster which the Company send out every week, upwards of 10,000 tons are kept in stock to meet any sudden demands. Any one looking at the great output of gypsum would be disposed to wonder what all this plaster could be utilised for. Amongst many uses we may mention that some of the best qualities of Plaster of Paris are so famed for their excellence that they are often sent to Paris and Berlin. Out of the large number of buildings which have been adorned with the plaster supplied from this Company's pits, we may mention the Cape Town Houses of Parliament, the Alexandra Palace, The Grand Hotel, Charing Cross; Earl Manvers's new mansion, Thoresby Park; Duke of Newcastle's private chapel, Clumber; English Opera House, Covent Garden, London; Adelphi Theatre; Grosvenor Hotel, Victoria Station; and the London Exhibition, 1862. In connexion with the Exhibition, Messrs. Kelk & Lucas, the contractors, procured samples of Plaster of Paris from different manufacturers, and had them tested by the tensile test. The Company's plaster stood the greatest breaking weight, and was pronounced the best. From these pits material has also been supplied for the moulding of many well-known London statues as well as for extensive decorations in Athens, and many other large buildings throughout the world.

The making of beautiful enrichments only represents one of the uses, however, to which Plaster of Paris is applied. It is in constant request by modellers and sculptors, and many of the fine figure copies or plaster casts in the British Museum are made of Newark plaster. The Italians also use it for making their images and crucifixes. The best kinds are supplied for making Keene's and Parian cement, and for use on walls where fine work is required, it is admitted that the plaster supplied by this Company, as chemically prepared, is of the very best quality. Another important department of decorative art for which plaster is used, is that known as Scaglioli work, the making of imitation marble pedestals, which are worked so skilfully, as to be almost undistinguishable from marble itself.

Thus far we have spoken only of Plaster of Paris, but we find that gypsum is in large and increasing demand for agricultural purposes. Speaking of its use on the Continent, a writer in Knight's Cyclopædia (p. 515) says, "It is generally considered a proof of good farming when no reasonable expense is spared to procure gypsum or peat ashes, which are found on analysis to contain sulphate of lime." The same authority says that "on good loams containing a due proportion of humus, and on all light and dry soils which are not very poor, its effects are striking." Benjamin Franklin tried its fertilising power on clover. He sowed it in a clover field near one of the high roads of Pennsylvania so as to form the letters of a sentence such as the following,—"This is manured with gypsum," and the effect was such that the letters could be readily distinguished by the height and colour of the clover where the gypsum had been sown. In the supply of gypsum for agricultural purposes, the Company do an extensive business, while their

terra alba is largely used in colour and other manufactures. Modern science has also discovered a method of utilising gypsum for adding, by what we may call natural means, to the chemical properties of water. The *Daily Telegraph*, in an able article on British Beer on October 29, 1886, says: "The analyst has examined the waters of Burton and has found their virtues to consist in certain saline ingredients, but especially in gypsum, or the sulphate of lime, and he has finally discovered that with a scientific knowledge of the quality of any source of supply the proper saline ingredients may be added, so as to obtain a water resembling that of Burton." As the Company's gypsum is peculiarly pure we may expect it to be largely employed in this manner. Lastly, there is the use of the stone in a raw state.



THE NEWARK WORKS.

Sulphuric acid can be obtained from it, and it is useful in glass-making and various chemical manipulations. Very pretty specimens which come from fissures or breaks in the rocks are sold for grottoes, and for the ornamentation of gardens, vineries, and aquaria. It will thus be seen that with so many demands for the gypsum which this Company supplies, the large additions which have been made of late years will be fully needed. The development of artistic tastes, and the continued progress of chemical science will make the Newark plaster-beds of increasing service to the community, and from far and wide the mineral wealth of Newark and the Vale of Belvoir, which this Company brings to the surface, will be laid under requisition. We should add that the Company are also brick-makers and have supplied great numbers of bricks for railway tunnels, for important buildings, and for the London markets.

The Plastic Decoration and Papier-Mâché Co., London.

WHILE the names of Louis XIV., Louis XV., and Louis XVI. in France, and Queen Elizabeth, Queen Anne, and George II. in England, are associated with special and distinctive styles of architectural decoration, the reign of Queen Victoria has been distinguished only by efforts at an accurate reproduction of the most approved of the old styles. The knowledge of these various styles, and the taste for using them in both exterior and interior decoration, have, therefore, during Her Majesty's reign, largely developed. As regards the latter decoration, nothing has tended more to assist the growing appreciation of a tasteful interior than the facilities which the present methods of executing work of this character afford.

Down to the beginning of the present century the ornamentation of ceilings, friezes, and such like was effected by modelling each portion of ornament on the ceiling itself in a soft, plastic material made of lime and other ingredients, and known as stucco. This work could only be efficiently accomplished by skilled artists; and ornamental work of any importance, therefore, under this system not only occupied unlimited periods in execution, but cost fabulous amounts. While for ornamentation close to the eye, such as for dados, chimney-pieces, &c., where stucco work was too fragile, carved wood only was adopted. The use of stucco was superseded by means of the quick-setting material, plaster of Paris or gypsum. The methods by which this material was utilised are as follows:—The ornaments are first modelled in clay; a mould is then made from this, and casts obtained in plaster. These casts are stuck on to the plain surface to be ornamented, and a great saving in time and cost so effected over the older methods of modelling the ornaments *in situ*—ordinary artisans being able to do the same work that formerly required artists to accomplish. But although this system is extensively adopted up to the present day in suburban villas and cheap houses, it is now condemned by the best architects, and is seldom ever used in large or important edifices. The enrichments, cast in a mould as described, form a large solid lump of plaster of great weight and great brittleness, and are liable on these accounts to become displaced, forming a disfigurement and a positive source of danger. Further, in any design of great elaboration, the cost of this system is excessive compared with the more modern methods. Mr. R. W. Edis, F.S.A., in a "Cantor" lecture delivered before the Society of Arts, asks: "What could be worse than the wretchedly-constructed decorations in the shape of plaster cornices and centre flowers to be seen in most houses?" and proceeds to point out the advantages of the newer methods, which, he says, are "infinitely better than daubing two or three coats of heavy plaster on to walls and ceilings."

The place of wood-carving is also now taken for many purposes by plastic substances of more or less tenacity, which are pressed into moulds, and which, while damp, are flexible and pliable, and so capable of being put in any form, but, when dry, are hard and strong. The execution of such interior decorative work, according

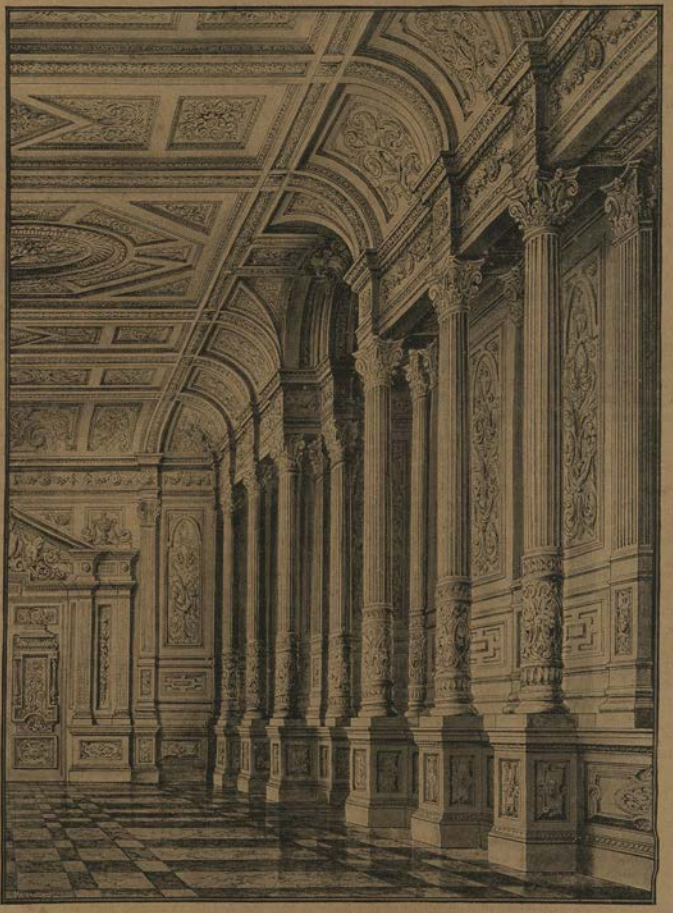
to the most modern and approved methods, forms the very extensive business of the Plastic Decoration and Papier-Mâché Company.

The Firm, originally founded by Mr. Charles Bielefeld in 1826, for many years confined itself to working that gentleman's patent for papier-mâché decoration, and executed some notable work in this material. It consists of paper reduced to a pulp, mixed with certain substances which give it consistence. It is subjected to great pressure in metal dies having the form of the ornament, and is thus thoroughly consolidated. After drying, it becomes a hard, tough, and very durable material, which is almost impervious to moisture, can be cut, bored, or in other ways treated as wood is, and is capable of taking the sharpest impressions. For very many decorative purposes this is, perhaps, the most efficient material known; for open work, such as is required in a ventilating centre flower of a ceiling, or in the enrichments of a ventilating cornice; for ornamenting dados, doors, or other portions of a room likely to be subjected to violence; for Corinthian capitals, or work requiring large projecting leaves, &c., this material still stands unrivalled either as regards price or efficiency. Samples of it executed by the Firm may be seen in Windsor Castle, Buckingham Palace, Dublin Castle, the Carlton Club, the British Museum, which have stood the test of nearly half a century. The fact of its having to be pressed in metal dies gives it this disadvantage, that considerable initial expense has to be incurred for these before an ornament can be produced. But the company has in its possession over 3,000 metal dies of every conceivable form and style which have been collected during the progress of the business, and which are estimated to have cost over £20,000, and of which they now give their customers the advantage.

While however, papier-mâché is unrivalled for some purposes over all other materials, it has been superseded for others by a material generally known as canvas or fibrous plaster. Fibrous plaster consists of fine plaster of Paris, cast in suitable moulds, layers of canvas of a certain texture being pushed by the fingers nearly to the surface of the mould, and the whole being held together by a wooden framework backing. These materials, on becoming incorporated, form a compact, tough mass, with considerable flexibility, and with a beautifully smooth face. The projecting enrichments form a portion of the cast, and can therefore by no possibility become detached. It can be made in any complexity of form, such as curved coves, arches, or domed ceilings, or in plain or enriched slabs, to any size convenient for the purposes of transport or fixing. These slabs are placed in a hot room until thoroughly dry, and are then ready for being screwed up in place against the joists or beams of a building, so dispensing with all bracketing and lathing. The joints between the slabs are sometimes arranged so as to be covered by an enrichment and are so hid, or they can be easily and efficiently stopped with shreds of canvas and plaster. The fixing and stopping is accomplished by ordinary workmen with great rapidity and without dust and mess, which accompanies ordinary plaster-work. It is in this material that decorated ceilings, cornices, friezes, columns, pilasters, and such ornamentation are now principally executed, and it has received the warm approval of all the best known architects of the day. It is virtually fireproof, and is specified by the Metropolitan Board of Works of London as the covering for all iron or wood-work in the public buildings under their control. Owing to the strength and tenacity given to it by the canvas and wood used in its manufacture, it has no liability to crack even when subjected to considerable vibration. It is, when finished, perfectly dry and ready for painting, and can be safely packed and dispatched for export. Excellent specimens of this material executed by the Company can be seen in the Great Eastern Hotel, Liverpool Street, London, E.C.; the new Hall of the Worshipful Company of Butchers, Smithfield, London, E.C.; the Royal Colonial Institute, Northumberland Avenue, London, W.C.; the Pavilion Music Hall, London; the new H.M. Theatre and Opera House, Sydney, New South Wales; and in hundreds of other public and private buildings.

In some styles of decoration the ornamental figures take an infinite variety of form, having great width and projection. For such as these, especially when near the floor, the Company use a well-known material named carton-pierre, which consolidates with little pressure, and can so be pressed by the fingers in any kind of mould, the great expense of metal dies being thus avoided, and the material, in dry situations, is quite efficient. While the Company make every effort to obtain a reliable material in which to carry out these different operations, and also a material involving the smallest expenditure of labour in execution, they pay the utmost attention to producing only work of the highest artistic excellence. With this object they employ a staff of the most experienced artists and modellers, who design for architects and others, and superintend the execution of orders, seeing that every turn and line has its proper significance and conveys the proper feeling.

The following original design by Mr. Parlby, their artist, illustrates a treatment for the interior of a hall or vestibule, and shows the capabilities of the materials they employ for decorative purposes.



PLASTIC DECORATION.

There is a widespread notion still existing, though rapidly dying out, that fibrous plaster, papier-mâché, and other materials of the same class, are shams or imitations of real work, the conception of people holding such being that all interior ornamental work should really be either in carved wood or stucco. But it is certain that the question of art is distinct from the question of material. The beauty of an outline or the grace of a form is precisely the same, whether in marble or clay. Recognising this, the Company make it their primary object to obtain absolute excellence in the models, and having accomplished this, they select for the carrying out the work that material which according to their experience most completely combines efficiency, durability, and economy.

The Company, though trading under the name which heads this article, on account of that name being so long associated with the business, consists of two gentlemen only; viz., Mr. R. Henry Brunton, Mem. Inst. C.E., F.R.G.S., M.S.A., and Mr. Herbert Brewster, who personally superintend all its operations. The Company's offices and show-rooms are at 21, Wellington Street, Strand, London, and are well worth a visit. Their factory is situated in Market Road, Caledonian Road, N.

The Rugby Portland Cement Company, Rugby.

ALTHOUGH started in the year 1868, the above-named Company achieved comparatively little success until 1872, since which latter date, however, the most extraordinary progress has been made; and from being a small and not very prosperous undertaking, the Rugby Portland Cement Works have developed into a large and highly successful concern. It would be a mistake to suppose that the absence of prosperity at the outset was due to anything but the want of skill displayed by the former management, seeing that the almost unprecedented success of recent years would alone show, if other proof were wanting, that exceptional facilities are enjoyed by the Rugby district for the manufacture of cement. At the present time the Company supply a large portion of the North of England, not to mention other parts of the country, with the bulk of the cement there used, which in point of strength and other qualities is second to none manufactured.

The material in question is not produced, as some people erroneously imagine it is, in the Isle of Portland, but derives its name from its similarity in colour to the celebrated Portland building stone. Hydraulic cements excellent quality were used, as is well known, by the Romans; but in modern times little was known about their composition before the investigations made by Smeaton, who lived in the last century. Since then the use of cement has become very general, and, thanks among others to the Rugby Portland Cement Company, a better article can be obtained now probably than at any former period in the history of civilisation. The stone most suitable for this branch of manufacture is Lias limestone, a formation of rock which in England extends from Whitby on the coast of Yorkshire to Lyme Regis in Dorsetshire. About Rugby the deposits of limestone and marl are admirably suited for the purpose; and if there is anything to be surprised at, therefore, in connexion with the fortunes of the Company, it is that success was not met with from the very first.

In so large an establishment of the kind it is necessary to keep several powerful engines employed, which, as well as the rest of the machinery in use there, are of the most modern and improved construction. For the prompt execution of repairs, a carpenter's shop, a smith's shop, a wagon-repairing shop, &c., are all provided on the premises, where also large numbers of barrels are made in which to ship the cement. In regard to the kilns, many improvements have been effected by the present management, and both increased economy and greater efficiency are now secured. The number of men engaged in the Works is very considerable, for whose benefit a reading and dining-room was not long since erected.

The quarries whence the limestone is taken are close at hand; and the stone, having been placed on trucks, is drawn up an incline to the Works. Here it is laid in sheds, and all refuse adhering to it is carefully removed. When thus cleared, and subsequently dried, it is passed through Blake's stone-crushers, of which several are constantly in use on the premises, night and day. Having been subjected to the crushing process, it is run into hoppers, and eventually taken to the top of a building and ground between mill-stones. The grinding process

is an expensive one, as the furrows in the burr-stones which are used soon lose their edge in reducing the limestone to a powder, and no fewer than ten men are kept constantly engaged in renovating them. Various attempts have been made to invent a steel or metal grinding-mill that shall supersede the kind now in use, but so far without any marked degree of success; the celebrated French burr-stones, in spite of their imperfections, are still found on the whole the best. When the grinding is completed, the future cement is again raised to the top of the building, and there mixed with water in horizontal mixing-boxes, after which a more complete union of the two is effected in the vertical pug-mills. The next operation is to form the mixture into bricks, and place these on the drying floors, whence, when sufficiently dried, they are taken to the kilns, and alternate layers of bricks and coke there piled up. The kilns, each of which takes about twenty tons of coke, are cleared out on an average some three times in a fortnight. When the bricks are removed, a portion of the process through which the material has already passed is repeated; they are first broken up in crushers, and then ground as before, after which the powder is carefully sifted, and the coarser particles sent back to be re-ground. The sifting and re-grinding are of the utmost importance, as a high degree of fineness is essential. Finally, the manufactured cement is packed in barrels or sacks, and after being weighed is ready for despatch by one or another of the lines which have aided in making Rugby a great railway centre.

Among the excellent qualities possessed by the Rugby Portland cement are its capability for carrying a large proportion of aggregate when made into concrete, and its great strength. In the case of ordinary stone employed for building purposes, the effect of age is to decompose and weaken the material, a process which is brought about by the carbonic acid gas absorbed from the air; but with Rugby Portland cement the opposite effect is produced by age, the strength of the material increasing as time goes on. To illustrate this fact, as well as to show the degree of strength attained by the cement of the Rugby Company, we have given the average results of tests for the month of March last. The pieces of cement experimented on were an inch square. Upwards of forty briquettes are made from each day's delivery and are then placed in water; after remaining there seven and twenty-eight days respectively, they are tested in one of "Adie's Machines," in sets of three each day, and the average breaking strain of 232 that had been in water seven days was 556 lb., and of those of twenty-eight days 804 lb.

It must not be forgotten, however, that, no matter how carefully and well cement may be manufactured, the requisite knowledge must be possessed and the proper care taken by the user, if it is to give satisfaction. Nor is it fair that the manufacturers should be blamed for results brought about by the ignorance or carelessness of those who employ their goods. Many people seem to imagine that cement can be used anyhow and with any material that happens to be ready to hand; whereas it is essential for the production of good concrete that the foreign matter mixed with the cement should be of the right kind and quality. For the benefit of those whose experience in the matter is limited, the Rugby Portland Cement Company have issued an excellent little pamphlet on the subject, containing many practical directions and hints.

So celebrated has the Rugby cement become that caution is needed by the purchaser lest an inferior article should be passed off on him by unscrupulous parties under the name of Rugby. Every possible care is taken by the Company to make the tests of their cement thorough and reliable, in order that their customers may be well satisfied. But to describe the different methods by which trial is made of their goods in the sample-room would occupy too much space. Among the many uses to which Portland cement is now advantageously applied, we may mention the construction of such things as door-steps, window-sills, paving slabs, pipes, busts, and all kinds of useful and ornamental work required in the building trade; but, indeed, the list of purposes to which it may be turned, either by itself or in combination with other materials, is well-nigh endless. We need hardly say that great numbers of testimonials have been received from all quarters by the Rugby Portland Cement Company.

Messrs. Taylor, Tunnicliff, & Co., Hanley.

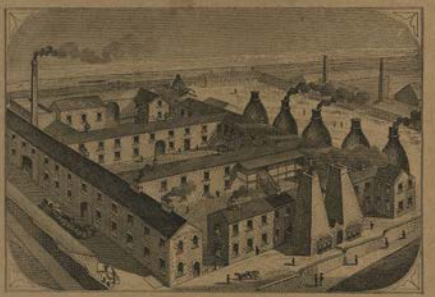
STAFFORDSHIRE Potteries are justly celebrated all over the world for the beauty and quality of their ceramic manufactures. About the year 1755 to 1760 Burslem was one of the chief towns in the Potteries. There the genius of Josiah Wedgwood inspired the trade, and made the ceramic art of Great Britain to be respected and appreciated by foreign countries. Since then the Potteries have ever flourished, and well-known men like Spode, Minton, Copeland, and many others have laboured zealously to improve and propagate this beautiful art. Where so much merit is due to many good men and true, it is difficult to single out individual firms unless some especial feature can be fairly claimed by them. In our opinion, Messrs. Taylor, Tunnicliff, & Co., Hanley, deserve our special notice, for they have done much to merit the high repute which they enjoy. Self-made men who are not ashamed to own that their success is the result of their own individual hard labour are men whom Englishmen should honour, if only because England owes its commercial greatness to a large extent to the individuality and genius of such men.

Thanks to the courtesy of Messrs. Taylor, Tunnicliff, & Co., we are enabled to give our readers some insight into the processes of a china and earthenware manufactory. There are few branches of industry more interesting to the visitor, or more calculated to excite pleasant wonder than that of producing a perfect piece of china,—rough, hard stones, flints, ugly-looking clays, calcined bone, and similar materials, being freely used in the manufacture of the "crockery" articles we see around us, while every piece must, in turn, pass through the hands of a large number of skilled workpeople before it is finished. To commence with, the whole of the insoluble materials which form some of the component parts of a piece of earthenware have to be "ground," —that is, levigated in water until they are reduced to a cream-like mass, that will pass through fine silk sieves, technically called "lawns,"—and this substance has then to run the gauntlet of an army of magnets to extract everything of the nature of iron. The fluid mass, having been correctly compounded in the necessary proportions of clay, flint, stone, &c., is then pumped into fluted chambers lined with calico, whence the hydraulic pressure forces out the water, leaving the clay, or, as it is technically called, the "body," ready for the potter's hand; and it would astonish most people to see the beautiful and precise shapes which an expert thrower can produce in clay, unaided by anything else but the skilful manipulation of his own fingers.

We were privileged to see the application of an entirely new process, recently introduced by this Firm, whereby an effect is produced which cannot be done by any other means. The result is called "Tapestry Ware," and the Firm are justly proud of it, as it was entirely their own discovery, assisted by their artist, Mr. W. H. Slater. It is artistic in every sense of the word. By this treatment the surface of the article is made to represent a granulated (or matted) appearance; hand-painting is done on this irregular surface, and coloured after the most renowned specimens of old tapestry, and, where necessary, the pattern is defined by

threadings and interlacings of the precious metals, the effect of the whole being that of a rich mass of decoration, blended and subdued in tone, giving a feeling of pleasure and repose to the eye as distinct from the somewhat glaring effect observed in a highly-glazed surface. Of course, this style of decoration is not applied to common articles, but is generally reserved by the Firm for such things as lamps and candelabra, also for salad-bowls, biscuit-boxes, cruets, and other similar goods, afterwards mounted by silversmiths. But few things can be conceived to excel in richness and beauty the charming vases, in varying descriptions and styles, which we saw in this Tapestry Ware, and which the Firm are reproducing in marvellous variations of shape and design.

Messrs. Taylor, Tunnicliff, & Co. do not make the ordinary table and domestic earthenware of every-day use, but have developed a business which is comparatively peculiar to themselves, so that a visitor to their Works sees not only all the recognised processes of making and decorating earthenware, but much more than these in the thousand and one articles of every conceivable shape and size which are here evolved by the "Potter's art." In 1867 this Firm commenced business at Havelock Works, Hanley, their then object being to produce what is technically known as door furniture, which may be more fully explained as meaning door-knobs, finger-plates, castors for furniture, electric bell roses, &c., and both members of the Firm had received a practical training in the production of this class of goods. Himself a Birmingham man, Mr. Taylor had considerable experience as to the various earthenware articles which were, or could be, adapted to the brass-fitting and similar branches



of hardware manufacture. With this he combined a natural taste and liking for the treatment of mechanical processes, which has enabled the Firm to bring to perfection many useful and beautiful articles, never before accomplished in the Staffordshire Potteries. Mr. Tunnicliff also had received a severe training under some of the most thoughtful and skilful manufacturers in the district, which he successfully applied to the many intricate processes necessary to produce good earthenware and china. Notwithstanding these advantages, however, the partners, like most other men who have founded businesses, had much shoulder-to-shoulder work to do before they found their ship floating in anything like peaceable waters; still, by dint of hopeful energy, they were able, in a few years, to establish a business with which the Havelock Works could not cope, it having gradually extended into other channels than the original basis. In 1876 the Firm found themselves compelled to seek larger and more convenient premises, which resulted in their purchasing the manufactory they now occupy at Eastwood, Hanley, besides which from time to time constantly increasing demands have had to be met by additional buildings, machinery, and plant, until now the proprietors find themselves in possession of a commodious and compact establishment, containing within the four boundary-walls every requirement for their business; whilst an experience of twenty years, combined with the skill or ingenuity of one or both of the partners, has enabled them to introduce and adapt many machines and appliances peculiar to themselves as circumstances have arisen. In former days, an earthenware manufactory was frequently a rough, slovenly, dirty place, and the comfort of the workpeople was but little considered. Now, however, all that is changed, and potters are alive to the fact that cleanliness and neatness are very conducive to the good results they seek to produce in the shape of clear, bright articles.

In a manufactory such as that of Messrs. Taylor, Tunnicliff, & Co., where articles are produced varying in size from a groat to large vases thirty inches high, thrown and turned all in one piece, and similar heavy goods all made from plastic material, which has subsequently to pass through an extreme heat, whereby vast differences of contraction are produced, it necessarily follows that none but very expert workmen can be relied upon to produce goods which at the finish shall be of unvarying size; and Messrs. Taylor, Tunnicliff, & Co. pride themselves upon their old servants, who, by their length of service, have become possessed of a unique experience valuable alike to masters and men. As an instance of this, we may mention that we saw one man at work who for twenty years had been engaged by this Firm in making nothing else but handles of different kinds, so that in all probability he can produce these in greater accuracy and precision than any other man. And it is worthy of note that at the last Turners' Company competition, held at the Mansion House, three of the employés of this Firm were successful,—one taking a first (Silver Medal) and a fourth prize, another a second, and the other a fourth prize, the competition being open to the United Kingdom.

As some of the processes in an earthenware manufactory are, if negligently dealt with, injurious to the health of the workpeople, it was interesting to note the care taken of their health in the shape of ventilation, and the strictly-enforced rules compelling those who might be so silly as to neglect to carry out those precautions whereby the workpeople may keep themselves in thorough health. Of course, Messrs. Taylor, Tunnicliff, & Co. still retain the hold they gained upon their original trade, so that we found ourselves in the midst of door furniture of every conceivable shape and form, and decorated in every degree, from plain gilding up to high-class hand-painting. As every one knows, decoration forms a large item in the production of china and earthenware, one of the most generally adopted being that of printing, which is done by means of taking an impression of the required pattern from a copper-plate on soft tissue paper: this is laid on the piece of ware which requires decoration whilst the ink is wet, and as the ware is in an unfinished or "bisque" state, the porous body absorbs the pattern, and the paper is washed off, leaving the design impressed upon the earthenware, which, after some other intermediate stages, is dipped into a solution of borax, lead, &c., technically called "glaze," which in passing through the oven forms a thin coating of glass all over the piece of earthenware, through which the printed pattern is visible, but immovable. In this way we saw names and decorations applied to such articles as scale-plates, thermometers, bath-fittings, stationers' and artists'-colourmen's china, &c. This style of decoration, namely printing, is generally adapted for the cheaper class of goods, whilst for their large hall and table lamps, they usually apply either elaborate gilding or hand-painting, though in many of them much of their beauty is acquired in the shape and proportions of the lamps themselves.

The work of Messrs. Taylor, Tunnicliff, & Co. also deserves a special record, inasmuch as every article they manufacture has to go into the warehouses of the different metal-workers, lamp-manufacturers, and others to whom their Pottery is supplied; and as they only manufacture really for "the trade," and have to work from patterns and specifications, the utmost accuracy is necessary. They are what is called nowadays "self-made men,"—men who have begun from the bottom of the ladder, and have gradually, but surely, raised themselves, by their indomitable energy and perseverance, to the very topmost rung. They are deservedly esteemed, not only by the firms for whom they work, but also by their neighbours and competitors, and the twenty years of their activity have earned for them a reputation of which they may be justly proud, and which places them amongst the numbers of commercial firms who have, indeed, contributed so largely to the commercial importance of Great Britain.

Mr. J. D. Wright, London.

PERHAPS no science has made such rapid progress during the last fifty years, and is, at the same time, of so much importance to the general well-being, as that of hygiene and sanitary reform. Warned by the voice of the past, and impelled by the needs of the present, modern invention has been fruitful in producing appliances for increasing the general health and comfort, foremost among which stand the improvements in smoke prevention. A large proportion, probably the majority of houses, are subject in a greater or less degree to this annoyance. Among the numerous inventions brought before the public—all pronounced the best—we should find it hard to choose, but for the fact of our attention having been called to the now widely-known "Climax" Smoke Preventative Chimney-top, manufactured solely by Mr. J. D. Wright, of 2, St. Michael's Road, Stockwell, London, S.W. This invention has proved a great success in curing such intolerable nuisances as smoky chimneys. The principle on which the "Climax" is constructed is as ingenious as it is successful: the base is so made as to concentrate the whole of the heat of the chimney towards the apex, and thus prevent the cold air from passing down.

The central and most important portion is an helixicon, forming successive convolutions each of which in turn slightly overlaps the other; the space between the convolutions being about one and a half inches. The effect of this spiral is a continuous upward current which by its force effectually excludes down draught, alike in fine and stormy weather. A cylinder is then placed on the spiral band which has vertical openings, leaving segmental sides between each space which are opposite to and in unison with each other, thus giving it an ornamental appearance, and what is of much more importance materially adding to its efficiency by causing a strong suction; the whole being strengthened by a most important improvement—three strong continuous steel bars shaped to the required form, to which all the parts are firmly riveted.

The advantages of the "Climax" over its compeers consist in a few special features which we will briefly mention: the simplicity of its construction and the width of its top permit of its being easily swept; it is perfectly noiseless; and is equally effectual from whatever quarter the wind may blow.

Mr. Wright has introduced also the "Lilliput" Climax Top for the use of cottages and small properties. It is constructed upon the same principle, above described, but is made so as to be readily fastened into terra-cotta pots that may be already fixed on the chimney, and is so low in price as to meet the requirements of the million.

The great value of the spiral construction of the "Climax" arises from its harmony with the laws of Nature. The cyclical character of many winds, the curling of smoke, and the motion of waterspouts are well-known examples of a spiral tendency in atmospheric disturbances. It is in working in unison with natural laws that the highest results may be expected. Based on a principle at once so simple and scientific, and abundantly approved by experience, we venture to predict for the "Climax" a future of still greater usefulness and success.

Messrs. Benjamin Winstone & Sons, London.

MR. FOSTER, who introduced the composition for covering the printers' inking-roller,* established this business early in the present century. At that time printing was done at hand-presses only, and was very limited when compared with the publications of the present day. The demand for printers' ink was, consequently, very small, so that printing-ink manufactories had not nearly reached the dimensions now required for supplying the demands of the newspaper and other printing establishments.

On the death of Mr. Foster, his son, Benjamin E. Foster, carried on the business at James Street, Walworth. In 1849, Mr. Winstone, the head of the present Firm, having given up the practice of medicine, for which profession he was educated, entered into partnership with Mr. B. E. Foster, when the name of the Firm became Foster & Winstone. The following year they took 100, Shoe Lane,† and extensive premises in the rear, where a steam-engine and grinding-mills were erected in order that they might have increased facilities for supplying the various kinds of printing ink, for which a demand was arising, through the use of coloured ink for theatre play-bills and for broadsides, previously printed in black ink.

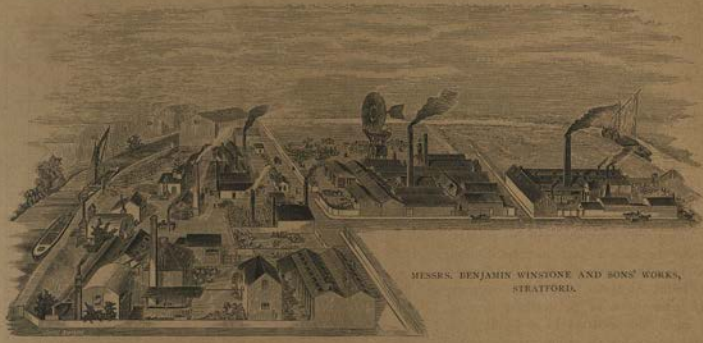
The change that was made by the Governor and Directors of the Bank of England in the manner of printing the Bank notes, from copper-plate printing to surface or letterpress printing, brought the Firm more prominently into notice; and an introduction to Her Majesty's Stamp and Stationery Offices soon followed. Mr. Alfred Smee, in the paper ‡ "On the New Bank Note, and the Substitution of Surface-printing from Electrotypes for Copper-plate Printing," read before the Society of Arts, December 20, 1854, says:—"The printing-ink for the Bank note is also a matter which has received attention. The properties of ink, when carefully prepared, are very curious, and require considerable judgment to adjust them to particular papers. To Mr. Winstone, the printing-ink manufacturer, has been entrusted the preparation and adaptation of the ink for the note, and required somewhat careful treatment, for the peculiar arrangement of black and light in the

* Mr. Hansard, in his "Typographia," 1825, page 623, after mentioning the invention of the Stanhope Press, and speaking of the efforts made by Lord Stanhope to produce a roller without a seam, to take the place of the pelt balls then in use, remarks:—"All that Stanhope so anxiously desired, and which even his invention and indefatigable powers could not surmount, was at length achieved by the mere chance observation of a process in the Staffordshire Potteries, in what are there called dabbers. These were formed of a composition which appeared to possess every requisite for holding and distributing the ink, imparting it equally over the form, and being easily kept clean, soft, and pliable. Mr. Foster, an ingenious printer, then in the employ of Mr. Hamilton, at the book-printing office at Weybridge, was the first who applied it to letterpress printing, by spreading it in a melted state upon coarse canvas, and making balls in all other respects in the usual manner. The inventors of machinery soon caught the idea, and, by running the composition as a coat upon wooden cylinders, produced the apparatus so long unsuccessfully sought by Lord Stanhope, and without which no machine-printing could ever have been successful."

† These premises, some years after, being for sale, were purchased by Mr. Winstone, together with several adjoining houses, and in their place he erected the extensive warehouse and manufactories the Firm now occupies.

‡ "Society of Arts Journal," 1854, page 85.

note. . . . In the Bank note it is also expected that the ink dries sufficiently to allow handling immediately after being printed, a property which Mr. Winstone's chemical knowledge has enabled him to produce."



MESSRS. BENJAMIN WINSTONE AND SONS' WORKS, STRATFORD.

MANUFACTORY IN THE REAR OF 100 & 101 SHOE LANE.

On the death of Mr. B. E. Foster, the same year, the surviving partner became sole proprietor of the business; and Mr. Winstone, preferring to carry it on in his own name, the name of Foster was omitted, and the name Benjamin Winstone only appeared in all transactions connected with the concern.

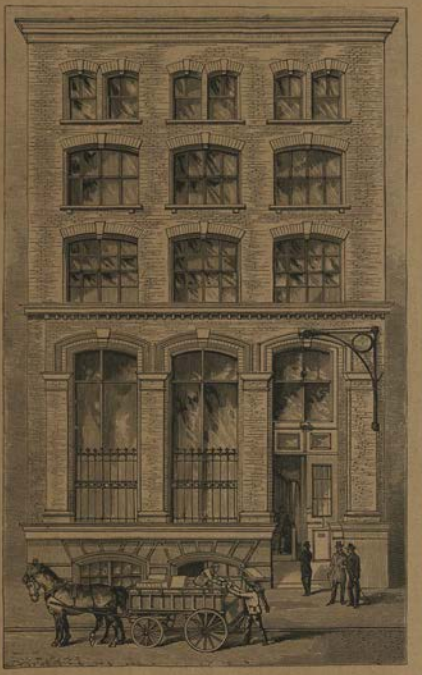
Several changes in the requirements of the age caused a development of printing beyond all anticipation.

Government having taken off the newspaper tax, as well as the duty off paper, enabled the newspaper proprietors to reduce the price of their papers, and, in consequence, the daily number became enormously increased. The railways also found employment for the printing-machine in the production of time-tables, way-bills, coloured notice-bills, ticket-printing, &c.

The introduction of the lithographic-printing machine allowing, as it does, of the rapid multiplication of colour illustrations for books, coloured labels for commercial purposes, and also imitation of water-colour and oil paintings, known as chromos and oleographs, opened up for the Firm a fresh branch of business,—in the importation of lithographic stones from Germany, and in the manufacture of lithographic varnishes and fine colours. From the causes just mentioned, and also from the requirements of the printers in India, Australia, and other colonies, the consumption of printers' ink became so much increased as to make a great extension of premises and manufacturing power necessary. Mr. Winstone, therefore, took a piece of ground at Stratford, of considerable extent, on which he erected a steam-engine and mills for grinding; and, as it was desirable to have the control of the manufacturing, so far as is possible, of the ingredients used in making printing-ink, he built, in addition to the mill-room, houses for oil-refining, varnish-making, and also buildings for the production of vegetable lamp-black and fine colours.

The manufacture of Frankfort or copper-plate black, and copper-plate oil, carried on under the name of Grosvenor & Co. for many years at 213, New North-road, has also been added to the Stratford Works; and suitable buildings erected.

At a recent date, Mr. Winstone's two sons, on leaving Cambridge University, were taken into partnership—Ernest H. Winstone in 1876, and Arthur B. Winstone in 1884—so that the Firm now consists of Mr. Winstone and his sons, and it is carried on under the name of Benjamin Winstone & Sons.



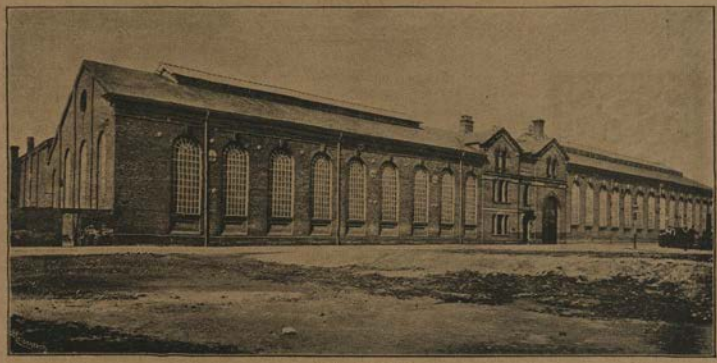
100 & 101, SHOE LANE.

The Haslam Foundry and Engineering Co., Limited. Derby.

SEVEN years after our present Sovereign had commenced her reign, that is, in the year 1844, was born at Derby Mr. A. Seale Haslam, now the principal proprietor, as well as manager, of the above important concern. He was the fourth son of the late Mr. William Haslam, who for upwards of fifty years had been connected with the iron trade of Derby. He was educated in his native town, where, too, he entered the works of the Midland Railway Company, and received a thoroughly practical engineering training. Having served his apprenticeship in these Works, he entered the employment of Sir William G. Armstrong & Co., and was engaged principally in the erection of hydraulic machinery; the hydraulic apparatus in use at Broad Street Station, London, was erected under his superintendence. In 1868, when his engagement with Sir William Armstrong terminated, Mr. Haslam, still quite a young man, left London and returned to his native town, where he began business for himself at what was then a small establishment known as the Union Foundry. So successful has he been in this enterprise that the Works have required extensive additions, until they now cover some four acres of ground, and the number of workmen employed on the premises has risen from about twenty to nearly four hundred. Since the year 1876, the business has been carried on by a limited liability Company, under the name and style of the Haslam Foundry and Engineering Company, Limited, Mr. A. Seale Haslam, M.I.M.E. and J.P. for the Borough of Derby, being the principal shareholder, and undertaking the management. The Company are extensively engaged in the manufacture of dry-air refrigerators, under both the Haslam and the Bell-Coleman patents; and some description of these machines is therefore necessary.

The refrigerating apparatus consists of a massive bed-plate, in which is the cooler for reducing the temperature of the compressed air; the whole is thus self-contained, and occupies but a small space, which is a great desideratum. On the top of the bed-plate, which constitutes a framework for the machine, are fixed the cylinders for the compression and expansion of the air, and also the steam cylinder. The drying-pipes are so arranged that, as the air returns from the cold chamber to be re-compressed, it circulates round them and causes the moisture within the compressed air to condense. Such a refrigerator as that which the Corporation of Glasgow has in use at Pointhouse is capable of discharging over 110,000 cubic feet of cold air per hour. Some slight modifications have been introduced into this machine, which is practically two machines combined, one of which can be kept working while the other is stopped for repairs or to be cleaned. One half has a high-pressure steam cylinder, an air-compressor, and an air-expansion cylinder; while the other is similarly equipped, except that for a high-pressure it has a low-pressure steam cylinder. The three cylinders are in each case arranged in a straight line, with one piston passing through them; and thus, while the compressing of the air in one provides work for the steam to do, the expanding of the air in another aids the steam in performing this work, and so economises fuel. Briefly speaking, the principle on which these well-known refrigerators act is as follows:—Air is received into one

cylinder at the temperature and pressure of the atmosphere, whatever that may be, and compressed until it has a pressure of forty-five or fifty pounds on the square inch. The compression of the air raises its temperature very considerably, although not so much as it would raise it but for a water-jacket which surrounds the compression cylinder. In the cooler, already mentioned, to which the compressed air then passes, and which consists of a set of tubes, also surrounded by water, the temperature is reduced until it approximates that of the water employed. Thence the compressed and cooled air is conveyed to the drying-pipes, where, as before stated, the temperature is still further reduced, and the moisture condensed and drawn off. It now passes to the expansion cylinder, where the essential part of the whole process takes place. As is well known by every student of physics, a gas, when it expands, and in expanding does work, necessarily loses in heat the exact equivalent of the work it performs; and, as the air in the expansion-cylinder while expanding helps to move the piston and do the work of the machine, its temperature falls enormously, and may even be reduced by one of these refrigerators to 100° or more below zero Fahr. The cold, expanded air then passes into the chamber which it is desired to keep cool, and which in this way may be kept constantly below freezing-point, or, indeed, at any temperature below that of the atmosphere outside which is ever likely to be



VIEW OF WORKS.

required. In this chamber, which by the Haslam refrigerator is kept perfectly dry as well as cool, all kinds of perishable food, such as beef, mutton, butter, eggs, milk, and fruits, may be preserved indefinitely, whether on land or at sea, in temperate climates or in tropical. Many other purposes also may be served by these invaluable machines; they are used for cooling hospitals and public buildings in hot countries, and for cooling rooms in breweries, dairies, chocolate-manufactories, and other establishments. In the bacon-curing industry, refrigerating machinery is of the utmost importance, as mentioned in our article on that subject. Special machines are made by the Haslam Company for the establishments of wine-growers, and for the manufacture of ice.

The refrigerator in use at Pointhouse, above alluded to, is employed to preserve meat slaughtered on its arrival from the United States and Canada. The different compartments kept cool by this machine have a joint capacity of about 45,000 cubic feet; and by means of "trunks" with sliding doors, through which the cold air is admitted, the heat of each compartment can be regulated as required. As a rule, the temperature maintained varies from 32° to 40° Fahr. The cylinders are capable of indicating up to 250 horse-power when the machine is working at full pressure.

Various attempts have been made, from time to time, to bring the vast meat supplies of New

Zealand, Australia, and North and South America within the reach of the British consumer; but, until the introduction of refrigerating machinery, with only partial success. The tinned Australian and American meats have never become thoroughly popularised; and the importation of live cattle is necessarily attended with considerable expense. It has gradually been found that the best method of importing meat is that of chilling or freezing the carcases during transportation; and so successfully has the system been developed of late that our foreign meat supply has been quite revolutionised. By means of a current of cold, dry air, obtained from a Haslam refrigerator, the cool chamber on board ships engaged in this trade is kept at a temperature of 15° or 20° Fahr., or any desired temperature; and here the carcases can be stored and brought over without the slightest danger of losing their freshness. The idea that meat so preserved deteriorates in quality and flavour is without foundation, and has probably been propagated by the prevalent custom of selling the best meat thus brought over as English, Welsh, or Scotch, and only the inferior qualities, which may have

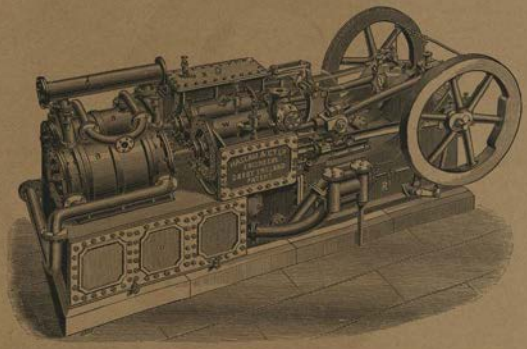
MR. A. SEALE HASLAM.

suffered from careless treatment, as New Zealand or Australian. There are two facts we can mention, either of which by itself should be quite sufficient to dispel this erroneous notion. In the first place, the salesmen of our principal markets utterly ignore it, and frequently preserve their meat in this way when an immediate sale cannot advantageously be effected. Thus, under Smithfield Market there are extensive cooling chambers, where four of the Haslam Company's large refrigerators are in use, and where English-killed meat is deposited for preservation whenever the market is at all overstocked. In the second place, in countries like Canada, for instance, where a considerable spell of cold weather can be relied on in the winter months, it is a common practice to kill a supply of meat when the cold first sets in, which lasts in a frozen state all through the winter, and this, too, in many cases where little is gained beyond a slight saving of trouble. Many of those who visited the Healtheries and Colonial and Indian Exhibition of last year will, doubtless, remember how excellent was the New Zealand mutton sold there, which had been brought over in chambers cooled by refrigerators.

Another trade, which has been created by the introduction of refrigerating machinery, is the trade in

fruit and vegetables between distant parts of the globe. Messrs. Scrutton, Sons, & Co., of Gracechurch Street, London, have fitted up one of their vessels, the s.s. *Nosparril*, with storage chambers cooled by a Haslam dry-air refrigerator, and have commenced to carry cabbages, French beans, peas, &c., from Madeira to Demerara, and tropical fruit from the West Indies to England. The Orient Steam Navigation Company and the P. & O. Company are also bringing fruit from Australia, in addition to frozen meat; and there seems no reason why an immense trade in fresh fruit and vegetables should not be done ere long between the Antipodes, the Tropics, and America, on the one hand, and the British Isles on the other, and perhaps between other parts of the world also.

A complete list of the different Governments, shipowners, meat storage companies, and other bodies, which have adopted the Haslam and Bell-Coleman Patent Refrigerators, would occupy more space than we have at disposal, and perhaps would not be very interesting to our readers. But a few general facts may be given in this connexion. Of all the refrigerated meat which is brought to England from abroad, about ninety-five per cent. is preserved by the Haslam and Bell-Coleman process; about 30,000 carcases are brought to England weekly; and upwards of 300 of these machines are already in use on land and sea. During the late Egyptian

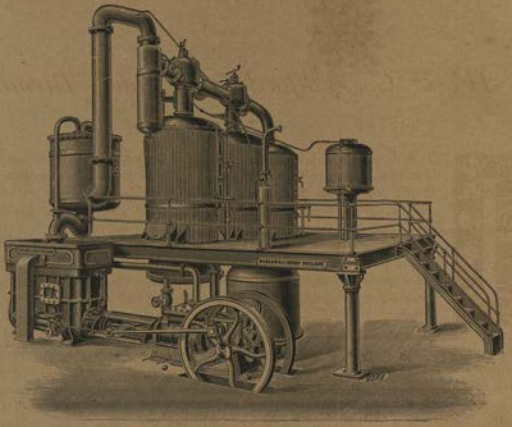


HASLAM'S PATENT DRY-AIR REFRIGERATOR.

campaign, the Haslam Engineering Company fitted with refrigerators four steam-ships for the British Government, namely, the *Amethyst*, the *Latharna*, the *Dunnurry* and the *Bulimba*, the object being to convey cargoes of ice for use in the hospitals. Following the example of the British Government, the Italian Government have lately had two steamers, the *Engineer* and the *Oceana*, fitted with the same kind of machinery, to carry ice to the troops at Massowah. The largest meat stores where the process is in operation in London are the Central Cold Stores at the Smithfield Market which are capable of holding about two thousand tons of meat. Other large stores have been supplied with the same kind of refrigerators, viz., at the East and West India Docks, at the London and St. Katherine's Docks, at the establishments of Messrs. Nelson Brothers, and at all the leading meat storage companies. In New Zealand numbers of these machines are in use, as many as four being employed in some instances by a single company. Other machines have found their way to Australia, and others again to the River Plate. Among the numerous shipping companies and firms of shipowners, some of whose vessels have been supplied with refrigerating machinery by the Haslam Engineering Company, we may mention the P. & O. Steam Navigation Company, the Cunard Steamship Company, Messrs. Henderson & Company, the Orient Steam Navigation Company, the Pacific Steam Navigation Company, the Shaw, Savill, & Albion Company, Messrs. Donald Currie & Company, the White Star Line, the New Zealand Shipping Company, and the Guion Line; and many other important lines might be mentioned also had we space.

The refrigerating machines of the Haslam Company, made under the Haslam and Bell-Coleman patents, have obtained a Special Medal and Certificate at the Sydney Exhibition, N.S.W.; a Gold Medal and Certificate at the Fisheries Exhibition of 1883; a Silver Medal at the Health Exhibition of the following year; a Gold Medal and First-class Certificate at the Calcutta Exhibition; and a Gold Medal at the Liverpool Exhibition of last year. Highly complimentary testimonials have been received from the Central Markets Cold Air Stores, Limited, of Smithfield, London, and from the River Plate Fresh Meat Company, Limited, the latter of which have already brought over, by means of the Haslam dry-air refrigerating machinery, some 700,000 sheep in first-class condition.

In addition to the manufacture of refrigerating machines, the Haslam Foundry and Engineering Company are largely engaged in the manufacture of steam engines, hydraulic presses, and sugar machinery in all its



TRIPLE-EFFECT APPARATUS.

branches. The accompanying illustration is engraved from a photo of a triple-effect apparatus. A large number of apparatus of this character have been sent to Java and other sugar-growing countries.

The advantages of the triple-effect apparatus are now generally admitted to be of the highest importance on all large sugar estates where economy of fuel is a great consideration. The mode of working the apparatus is as follows:—Exhaust steam, collected from various engines working in the factory, enters the heating-space of the first pan. The steam boils the cane-juice; the vapour from the juice passes to the heating-space of the second pan, producing a second ebullition; the vapour from the cane-juice in the second pan passes to the heating-space of the third pan, producing a third ebullition; the vapour from the third pan is drawn off by the aid of a powerful air-pump, thus obtaining a high vacuum, which reduces the boiling-point and enables the concentration to be carried on at a very low temperature. The apparatus is so constructed that the pans may be worked as single-vacuum pan or as a double-effect apparatus in case of need. These advantages will at once be apparent to all estate owners who are interested in high-class machinery of this kind.

Messrs. W. & G. Ashford & Winder, Birmingham.

HISTORY and tradition have established beyond doubt that among Birmingham Industries the manufacture of Saddlery dates back to an early period. A writer of the seventeenth century tells us in quaint language that "Bromicham drives a good trade in saddles and bridles, which find good vent at London, Ireland, and other parts." Since then Birmingham has continued to hold its own in this particular branch. This is saying much, as from the nature of the manufacture it is generally speaking less concentrated in particular localities than most others, and it bespeaks therefore exceptional merits on the part of local makers that their wares, in the words of the old chronicler, "find good vent in London and other parts."

The business of Messrs. W. & G. Ashford & Winder, which can boast the very exceptional record of more than a century and a half's existence, was established in the year 1730 in Cherry Street under the title of Ashford & Lord. Birmingham bore then a very different appearance from what it does now. The population at that time was but 23,000, as compared with 400,000 at the present time; and the journey between London and Birmingham, which now occupies less than three hours, took then, as is proudly boasted in a hand-bill of the period, only two days and a half. However, amidst all the changes and mutations of time, and the transformations which it has wrought, the business then established has continued to prosper, and to-day it occupies a foremost position.

From the commencement the Firm made it their special study to produce none but excellent work; their endeavour has always been to insure in their various articles of saddlery, strength together with lightness and convenience of form, and in furtherance of this end only the best qualities of materials are employed. Principles such as those here adopted could not fail to meet with recognition; and as the fame of the Firm became more widely known, orders increased, so that they were ultimately compelled to build much larger business quarters. The present premises at the corner of Kent and Essex Streets were built in 1850, and, as will be seen from the illustration given on the next page, they are of sufficient extent to afford accommodation for the carrying on of all the various processes connected with the manufacture of whips, saddlery, harness, purses, and the other leather goods connected with these branches. The present members of the Firm are Mr. W. G. Ashford and Mr. Charles Ashford, both young men who have had the advantage of practical training, having worked at the bench in every department of their comprehensive business. One of them now supervises the Saddlery and the other the Whip department.

Great ingenuity has been displayed by the Firm in the invention and introduction of important novelties; and valuable improvements have been patented by them from time to time. One of the earliest of these was the rubber disc at the top of whip sockets, which is now in universal use, and one of the latest the patent "See-Saw" cycle saddle, which is already meeting with considerable favour.

The range of manufactures produced is very large, and includes everything made of leather, except boots and shoes. Saddlery and harness form, of course, two of the leading specialties, and apart from military contracts, of which Messrs. Ashford & Winder have always received a good share, from both our own and Foreign Governments, the Firm also manufacture largely all classes of saddlery for private users. There is great diversity in the patterns available, and in all cases the object aimed at is to combine durability with clearness, and compactness of form, and gracefulness of outline.

Whips form a highly important branch of the business, and "Ashfords' whips" have been long noted for many special merits. We believe that the Firm holds the largest stock of seasoned hollies for carriage whips in the Trade; and in the manufacture of gut and whalebone whips it is their boast that they never have used, and never will use, old umbrella bone which is so largely employed in the manufacture of the cheaper class articles. In riding whips for ladies and gentlemen, jockey whips, hunting whips, and driving whips there is great variety. In many cases the handles are elegant pieces of art workmanship, composed of ivory, leather, bone, &c., with mountings of gold, silver, and electro-plate, ornamented by chasing and engraving.

Of purses and pocket books,—a cognate branch of manufacture,—the Firm have no less than fourteen hundred distinct patterns, all in their way excellent pieces of workmanship, specially adapted for their various

SADDLERY WORKS OF MESSRS. W. AND G. ASHFORD AND WINDER.

purposes, and finished in a most painstaking manner. The Firm's trade-mark—a Fox Head—as shown on the opposite page, has come to be regarded in Colonial and Home markets, as a voucher of standard quality. In Australia the Firm has long enjoyed almost a monopoly for the supply of the best class gut and whalebone riding whips, and of holly carriage whips.

As typical of the Firm's productions we figure herewith a few of their specialties. The saddle shown to the left in the upper corner is fitted with patent improved stirrup leathers. It will be seen that the new buckle there indicated holds back the point or loose end of the stirrup leather, leaving only the two thicknesses of leather between the rider's knee and the saddle. The loose end is kept in its place without any loops on the saddle flap, which are apt to cause the stirrup leather to bulge and chafe the rider. This new arrangement is a great improvement and is being widely appreciated.

The "Jubilee" Writing Folio is another specialty here illustrated, both open and closed. This is made entirely of best saffron stained hide, and is fitted with a patent nickel-plated lever lock. It has an arrangement for lengthening or shortening the outside strap which is quite novel, allowing the folio to be securely locked, whether empty or full of papers. It has large and small pockets, and is fitted throughout with the greatest care to meet the requirements of gentlemen—either tourists or commercial—who want a really good article,

convenient even to luxury, but without superfluity. If space permitted, many details of the various processes of the manufacture might be given which would be interesting to our readers. We must content ourselves with saying that this is one of the oldest and most legitimate industries of England. It deals with a raw material

TRADE MARK AND SPECIMENS OF LEATHER GOODS AND WHIPS.

indigenous to the country, and produces an article necessary to the comfort of the every-day life of the people. In these days of steam and electricity, it may be said that the old is giving place to the new; but whatever happens, in busy centres of population there will always be the country gentleman left, who will still proclaim that "There is nothing like leather."

The Chancery Lane Safe Deposit, London.

POSITIVE security against fire and theft is not very easy to obtain in this world; and those therefore who are possessed of valuables may well be thankful for the existence of such an institution as the above, where everything that the ingenuity of man can suggest has been done to reduce the danger from burglars and from fire to *nil*. Mr. Thomas Clarke, of whom we give a portrait, and who in 1885-6 was one of the Sheriffs of London and Middlesex, is the founder of the institution, and has, in addition, done much to improve the north end of Chancery Lane. About seven years ago, having acquired in that central and important neighbourhood a site comprising some 75,000 square feet, he commenced the erection of the new stone buildings, one of the largest and best appointed blocks of chambers and offices in all London. It was on reading the accounts of the River Plate Bank frauds, and of other successful attempts to steal deeds and valuables, that Mr. Clarke was induced to include in his scheme the construction of a Safe Deposit. For this purpose he secured the services of Messrs. Milner, the world-renowned safe-makers, whose London manager, Mr. J. M. Horner, ably superintended the work. The most modern improvements and inventions were adopted, in order to render the place as perfect in all its details as it could possibly be made; and the work was carried on regardless of expense, until at length, on May 7th, 1885, the Chancery Lane Safe Deposit was opened, with much *éclat*, by the Lord Mayor of London.

The locality in which the establishment is situated is well chosen for the purpose, on account of its proximity to the Law Courts: legal documents naturally form one of the most important of the different classes of valuables for which a safe place of keeping is either temporarily or permanently required. To avoid all danger from fire, the strong room and safes have been constructed below the surface of the ground; yet at the same time there is nothing of a sepulchral appearance about the buildings, but quite the reverse.

The Upper External Vestibule is entered through a handsome archway of polished red granite, and is protected by elegant wrought-iron gates and a portcullis; it is also guarded by trustworthy attendants. A broad and handsome flight of steps leads to the Lower External Vestibule; and as one descends, it is impossible not to be struck with the artistic character of the building. The staircase itself is composed of white marble and mosaic work, with a balustrade on each side of Jura marble; the ceiling is of enamelled iron tastefully designed; and the walls are of marble of various colours. At the foot of the staircase are iron gates leading into the Identification Lobby, where every depositor, unless personally recognised, is required to satisfy the manager or attendants as to his identity before proceeding further. The precaution thus taken to guard the property of depositors against every sort of danger should be fully appreciated by those who have valuables to be guarded. Not even the loss of the depositor's key to his safe need cause him uneasiness, when he knows that no one but himself, whether with or without the key, can obtain access to his property.

The Manager's Offices branch off to the left of the lobby; whilst to the right lie the Gentlemen's and

Ladies' Writing Rooms, the use of which is free to depositors. There are also private lockers, each consisting of a tiny room shut off from the rest, where depositors can retire to examine the coupons, private papers, or other valuables from their safes or strong rooms. Not only have those who make use of the Safe Deposit every facility for consulting their papers and for the writing of letters, but they can also have letters addressed to them here, which will be forwarded, if they desire it, by the manager.

From the Identification Lobby the depositor is admitted through yet more iron gates into the Internal Vestibule, around which are some of the strong rooms. On the right is a room for the deposit of plate, which can be packed along with other valuables in trunks or boxes and left there for any period, short or long. Opposite this, that is on the left hand side of the Inner Vestibule, is the strong room for cash-boxes, which may be brought every evening and removed in the morning at a trifling cost per annum. Perhaps the most interesting part of the establishment, however, as well as the most generally useful, is the portion which

MR. THOMAS CLARKE, FOUNDER OF THE CHANCERY LANE SAFE DEPOSIT, LONDON.

lies off the Inner Vestibule on the side opposite the entrance. It consists of six strong rooms devoted entirely to private safes, which can be rented, at very moderate prices according to size, by any one who desires to feel that his papers, deeds, jewellery, or other valuables are kept in absolute security. The rooms resemble passages three or four feet in width, on each side of which are ranged the safes, tier above tier, varying in size from 4½ inches, by 5½, by 18⅞, up to 23½, by 23½, by 18 inches; this is the inside measurement. Each safe, as an extra precaution, has a double lock requiring the use of two different keys at the same time in order to open it. One of these keys is held by the party who rents the safe, and no duplicate of it is made; the other is retained by the manager, as a protective key over the renter's lock, but useless to open the safe. Depositors can fix additional locks of their own on their safes if they choose, as in cases of trusteeship.

For convenience in handling the articles deposited, each safe is fitted with a japanned box, the use of which, however, is optional with the renter. Each of the strong rooms contains about a thousand safes, and is guarded by a door of enormous strength, weighing no less than two tons. The locks of these doors also are immensely strong, and each one is furnished with an ingenious clock-work arrangement which can

only be got at when the door is open. At the close of business hours the manager sets the clock-work locks according to the length of time that will elapse before business is resumed, and thereupon closes and locks the doors; not even he himself can then unlock them until the period for which they are set has gone by. In this way every possibility of the doors being unfastened during the night or on Sundays is prevented; and in case of necessity the locks can be set for a period of two or three days. The six strong rooms, in which the private safes are contained, are built side by side on iron columns, and though surrounded by concrete walls of immense thickness, are nevertheless entirely isolated from these, so that armed patrols can walk by night around, beneath, and over them. The armour of which they are constructed consists of steel and wrought-iron plates, and is the strongest ever used for such a purpose.

VIEW OF ONE OF THE STRONG ROOMS, FITTED WITH SAFES.

Below the portions of the establishment already described are the separate strong rooms, rented by those for whom the safes are not large enough. All the rooms are seven feet in height; but they vary in length and breadth from four feet upwards. The walls are of concrete several feet in thickness, and, as is the case with every other part of the establishment, these private strong rooms are perfectly dry; nor is anything of a combustible nature used in their construction. Each room has its own massive iron door, of which the renter alone has the key. This department is now being further enlarged, and when the work in hand is completed there will be five or six hundred of these separate strong rooms.

VIEW OF ONE OF THE CORRIDORS, CONTAINING STRONG ROOMS.

After what has been said it is needless to dilate on the security afforded for valuable property by the Chancery Lane Safe Deposit; to suggest a further precaution that might be taken, either against fire or against theft, would be well-nigh impossible. Among the classes of people for whom such an institution is peculiarly suited are trustees, who can have safes provided with two or more distinct keys, or combination locks, and so prevent trust property from being removed by one trustee alone. Country solicitors also, coming to London with deeds or other important documents to attend some case, and finding the case postponed, might often be relieved of much anxiety and responsibility did they avail themselves of the Safe Deposit. For testators, for solicitors, for trustees, and not for them only, but for whoever has important papers or other valuables to be taken care of, whether residing in London, the suburbs, or the country, the Chancery Lane Safe Deposit is an inestimable boon.

The Worcestershire Salt Works, Stoke Prior, near Droitwich.

DROITWICH, the ancient Salinæ of the Romans, is the seat of the important Worcestershire salt-springs, which were known prior to the invasion of Britain by Julius Cæsar; and salt, as a manufactured article, in point of tonnage is understood to be second only to iron—this ranking first in the United Kingdom—the quantity of salt manufactured being upwards of two millions of tons per annum.

In this brief article it is impossible fully to describe the magnitude of the operations at these Works, and we can, therefore, only summarise a few generalities. The buildings and appendages cover an area of about thirty acres, and the Stoke Prior Works Estate, under which are the salt-mines and brine-springs, comprise several thousand acres, extending for some miles in different directions, adjoining the Midland and Great Western Railways, and the Worcester, Birmingham, and Droitwich Canal. When the Works are in full operation the traffic in and out is about a thousand tons per day. There are private branches from the Midland and Great Western Railways into the Works, and nearly a thousand railway vans belonging to the Works are employed in conveying the salt to different parts of the kingdom. The Worcester and Birmingham Canal runs through the Works, and, communicating with the River Severn and all the other canals, forms a continuous chain of water communication to all parts of England. What is technically termed brine is formed by springs of water at considerable depth passing over beds of rock salt. Chemically speaking, there are various descriptions of salt; but the one, *par excellence*, is domestic salt, and from time immemorial it has been considered by the most eminent physicians as an element of life necessary to the formation of healthy blood, whether used for table, dairy, or curing purposes, provided it be in a state of purity; hence the ancient proverb, "Ex sale salus"—"From salt comes health" (see the *Lancet* and other medical publications on this subject); it is, therefore, most necessary to divest the public of the impression, where such exists, that all salt is necessarily pure, for that depends on the purity of the brine from which it is made. People cannot expect pure water from an impure fountain, by whatever name it may be called. For an interesting article on this subject, see "British Manufacturing Industries," by G. Phillips Bevan, F.G.S., also an article on Salt in the *Requisites of a Household*, by G. F. S. Francis.

So great are the cravings of nature for the necessary quantity of salt, that in Southern Africa and many eastern countries men will barter gold for salt; it is often used as a medium of exchange; and in all ages it has been the symbol of distinction, friendship, and hospitality. Horses, cattle, and sheep will travel hundreds of miles in search of salt marshes and lakes.

The beds of rock salt at Stoke Prior, Worcestershire, are deposited at a depth of from one to two thousand feet below the surface, and, owing to their great depth and the granite-like hardness of the material, the brine-pits at these Works occupied some years in sinking, and were most expensive in construction, having cost upwards of a hundred thousand pounds sterling, and the cost of the buildings and works several hundred thousand

pounds more. One great advantage of the position of these Works is, that from the great depth of the pits and the granite-like hardness of the earth's crust, there is no subsidence of the surface or the buildings, as is the case in Cheshire and other places. This concern is regarded as the model salt works of Europe, and the principal continental, as well as the American Governments of North and South America, have, from time to time, sent special envoys to inspect and report upon them. The great cost of these pits and Works has, in some measure, been compensated for by the discovery of a bed of *pure crystal* rock salt at a great depth below the surface, and which is the only known bed of the kind in England; hence the purity of the brine and the beautiful colour of the salt produced, as proved by the analyses of chemists like Herepath, Dr. Percy Frankland, Professor Tilden, and others. The fact that this salt has taken Gold Medals at the International Exhibitions in all parts of the world, the preference given to it, and the higher price it commands in the face of the most extravagantly hostile tariffs, is an unanswerable guarantee of its superior colour, quality, and purity.

For the last thirty-five years Mr. Corbett has made the manufacture of salt for table and other domestic purposes a specialty, and, regardless of cost, has revolutionised the mode of its manufacture. The two principal salt-producing counties in England are Worcestershire and Cheshire; but latterly rock salt, mixed with marl, lime, and other earthy matter, has been discovered at Middlesbrough-on-Tees; but in the absence of natural pure spring water on the face of the rock to make the brine, comparatively impure water descends the bore-hole. The salt so produced may do for chemical works, but for domestic, dairy, or curing purposes it is not likely to be preferred.

THE WORCESTERSHIRE SALT WORKS, STOKE PRIOR.

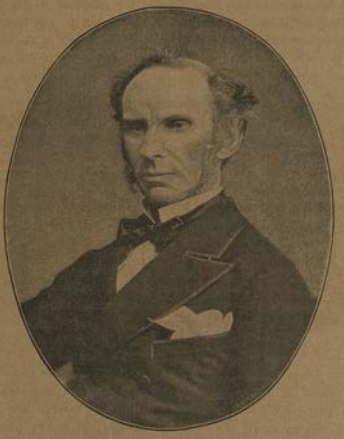
For nearly half a century some half-dozen individual proprietors, one after another, and two joint-stock companies with a subscribed capital of £350,000, failed to render this now prosperous concern a financial success; but some thirty-five years ago, Mr. John Corbett, M.P., became the sole proprietor, and by his practical, business-like abilities, energy, and perseverance, brought it to its present high state of efficiency. For some years, during its remodelling and reorganising, he slept over the offices on the Works, amid the smoke and steam, even descending the brine-pits from time to time when apparently insurmountable difficulties appeared. He naturally reflected on the previous failures of his predecessors, as the undertaking was to him a question of fortune or ruin. Happily Providence crowned his efforts with the most signal success. Nor has he been unmindful of those who have been associated with him in building up this enormous concern. For his workpeople he has built a small town of superior cottages with gardens attached, large schools, lecture-rooms, dispensary, and workmen's club; a chaplain is specially engaged to attend to the moral and spiritual welfare of the workmen and their families, and also a medical attendant in case of sickness or accident. Immediately after acquiring these Works, at considerable pecuniary sacrifice and great personal opposition, he abolished the use of female labour, which up to that time had been extensively employed in the manufacture of the salt. The residents of the district, recognising the improved moral tone resulting therefrom, inserted a handsome memorial window in the parish church to commemorate the event. In order that only men of good character and ability may be employed, so as to ensure the greatest possible care in the production of an article of a very superior quality, Mr. Corbett pays some 15 per cent. higher wages than is usually paid in the trade.

In the year 1879 Mr. Corbett erected, at a very considerable cost, on his estate at Droitwich, the Salters' Hall, which was opened by the Masters and Wardens of the Salters' Company of London, for the

purpose of public meetings, lectures, concerts, assemblies, &c., and it is considered the best building in the county for those purposes, being capable of holding 1,500 persons. The town of Droitwich is not very attractive, but is exceedingly healthy; and the surrounding country, like most parts of Worcestershire, is noted for its beautiful woodland scenery, hills, and valleys.

Pure salt has other virtues besides that of being a condiment necessary to healthy blood. The salutary effects of brine baths in cases of rheumatism, rheumatic gout, sciatica, skin diseases, and many other obstinate complaints have of late attracted the attention of medical men of the highest rank, and wonderful cures and beneficial results have been effected. Mr. Corbett has also, at great outlay, just erected at Droitwich an entirely new establishment of brine and other baths on the most scientific and elaborate principles.

For several years he has been the Parliamentary representative of the ancient borough of Droitwich, now absorbed into the division of Mid-Worcestershire, having succeeded the late Sir John Pakington, Bart.;



MR. JOHN CORBETT, M.P.

and, as an instance how history repeats itself, it is interesting to note that from some ancient documents belonging to the Droitwich Corporation, exhibited in 1884 at the "Health Exhibition," South Kensington, by the Worshipful Company of Salters of London, that the Corbets were connected with this salt borough as far back as the time of Edward I. Thus we read:—"Order from King Edward I. to the sheriff of Worcester to give aid and assistance to William Corbet and others in their inquiry for alleged misapplication of moneys raised for repaving the town of Droitwich," also "a commission from the same king to William Corbet and others for a similar purpose." A Thomas Corbet, also in the same reign, according to Nash's "History of Worcestershire," resided on the Impney estate near Droitwich, which is now occupied by the proprietor of the Works in question, and although the subject of this memoir claims no lineal descent from them, the coincidence is somewhat singular. He is also an honorary member of the Worshipful Company of Salters, one of the twelve great London Companies established in the year 1394, and licensed by King Richard II., "Sal sapit omnia" being the Company's motto. The "Elephant and Castle," the brand of the Stoke Prior Salt Works, is well known all over the world, as is also the "Black Horse," that of the London agents, Messrs. Weston & Westall, of 115, Lower Thames Street.

Mr. George Jennings, London.

THE name of George Jennings is known in every corner of the civilised world. The founder of the celebrated Firm of Sanitary Engineers, of Palace Wharf, Stangate, London, the late Mr. George Jennings, was not only the architect of his own fortune, but the first man who carried into practical effect the theories of the great sanitary reformers of his time, amongst whom he must be awarded a prominent position. It is difficult for the visitor conducted over the extensive works in Lambeth, to realise that Mr. Jennings commenced business almost single-handed some half a century ago. In an obituary notice which appeared in the *Builder* of April 29, 1882, it is stated that Mr. George Jennings established himself in Charlotte Street, Blackfriars Road, in 1838. It was then that his self-reliance, perseverance, and remarkable industry laid the foundation of his future success. It was at that time also that he fostered that originality of conception which resulted in the many inventions, in the development of which his thorough practical knowledge so much assisted him. The first which brought him prominently into notice was his Improved Shutter Fastener, which was highly commended by the leading trade journals of the time. In 1847 he produced his india-rubber tube taps, which were widely used and gained his first public award, the Medal of the Society of Arts, personally presented to him by the late Prince Consort, whose encouraging remarks on that occasion greatly stimulated him to increased exertions. He was consulted as to the arrangement of the sanitary works in connexion with the Great Exhibition of 1851, and their execution was entrusted to his care. At the close of the Exhibition he was awarded a medal, and received a flattering testimonial from Messrs. Fox, Henderson, & Co.; afterwards carrying out similar works on the removal of the building and its re-erection as the Crystal Palace at Sydenham, having to work day and night for their completion. Soon after the outbreak of the Russian War, under the direction of Mr. Brunel and Mr. Sydney Herbert, he constructed the sanitary fittings for the British hospitals at Varna and Scutari, also in the Crimea, where they were fixed by a staff of his own workmen. Later, having patented an improvement in the construction of stoneware drain-pipes, and experiencing some difficulty in securing its introduction by London potters, to whom it was shown, his attention was first directed to the extensive clay-beds at Parkstone, in Dorsetshire, and the idea of utilising the same suggested itself. He at once erected kilns and pottery-works, thus originating the extensive manufactories of stoneware and terra-cotta goods which have since so greatly developed and now cover many acres. A description of these works will be found on page 491, under the heading of "Terra-Cotta and Pottery Manufacture." In 1857, the development of his London business demanding further space, he removed to Holland Street, Blackfriars, where he gave attention more particularly to hydraulic fittings, and amongst other large operations, successfully constructed the entire works in connexion with the water supply to the town of Wilton, as well as the supply of the necessary fittings for similar works at Grantham and other towns. The site of the premises in

Holland Street being needed for the extension of the London, Chatham, and Dover Railway, he removed to Palace Wharf, Stangate. It was at this time that the utilisation of india-rubber for mechanical and other purposes was receiving much consideration, and having been induced to direct his attention to the subject, he erected improved machinery for its manufacture, and employed it largely in the construction of valves of all kinds. He also invented and patented an improved form of the endless elastic band, now so universally used, as well as several varieties of capsules for hermetically sealing bottles, jars, and other vessels. For several years his production of rubber goods of every description was very great, both in London and at a branch manufactory established at Birmingham. In the spring of 1865, the London Works were totally destroyed by fire, involving enormous pecuniary loss, the policy of insurance (owing to the anticipated occupation of the ground in the site of the present St. Thomas's Hospital) having been allowed to lapse a few days before. Undaunted by a disaster which seemed but to give fresh impetus to his energy, he took larger premises nearly opposite those destroyed, and where the business is at present successfully continued. Meanwhile, his business as a Sanitary Engineer was always increasing; the success which attended his work at the Exhibition of 1851 led to the sanitary arrangements of those of London, 1862, Dublin, 1865, and Paris, 1867, being also entrusted to his care, and at all of these Exhibitions he gained further distinction and awards. In 1872 he undertook the arrangement of rooms at St. Paul's Cathedral on the occasion of the service of thanksgiving for the recovery of H.R.H. the Prince of Wales; and in the autumn of the same year he commenced the drainage and other works in connexion with the Exhibition of 1873, in Vienna, which were placed in his hands by Baron Schwartz Senborn. This was a work of considerable magnitude, involving the construction of nearly five miles of stoneware pipe drains and the fitting-up of more than six hundred appliances. It was, however, successfully completed, and the Medal of Progress was awarded to Mr. Jennings at the close of this Exhibition. In later years he executed similar works at Paris in 1875, and at the Centennial Exhibition in Philadelphia in 1876; besides many smaller Exhibitions, he exhibited largely at Paris, 1878; Sydney, 1879; Melbourne, 1880; and Adelaide, 1881; at all of which he was successful in obtaining the highest awards.

MR. GEORGE JENNINGS.

It would be almost impossible to recall the many public and private works with which he was connected, but he often said with pride that, "from Mr. Hope's old house in Piccadilly to the City, Carlton, and Liberal Clubs," there was hardly a club in London but he often said with pride that, "from in which his appliances were used. His contracts with the Royal Engineer and War Departments and the Admiralty have extended over many years, and his works will be found in Government buildings in every portion of the British Empire.

His inventive faculty was very greatly developed: with him to see a plan, a scheme, or a piece of mechanism, was to endeavour (in many cases most successfully) to improve and simplify it, and he systematically refused to execute orders for fittings not in accordance with ideas he himself might form as to their utility. Since the date of his first invention in 1847, over forty patents were taken by him (many of which he had neither the time nor the opportunity to mature) for inventions, not confined alone to his own business, but ranging over a wide field of subjects, with which his daily busy life brought him in contact. In the spring of 1882 his useful and valuable life was closed, and since that date his sons have carried on the extensive business, progressing with the times, and proving worthy successors to the founder of their house. Visitors to the Health Exhibition of 1884 will remember the valuable and interesting collection of sanitary appliances exhibited by this Firm, and which obtained the highest honours.

On the occasion of our visit to the Works at Lambeth, we were deeply impressed with their magnitude; the business, to the smallness of which in its inception we have before referred, now being represented by an establishment giving direct employment to over one thousand men, while the number indirectly engaged it would be extremely difficult to estimate. Every workshop we passed through, filled with skilled artisans, was provided with the most modern and improved appliances, and we were particularly struck with the admirable arrangement of each department, facilitating the rapid production of every description of sanitary fitting. Not a corner of this human hive but had its worker, and it was instructive to note the value attached to the smallest space, and the ingenuity displayed in better utilisation

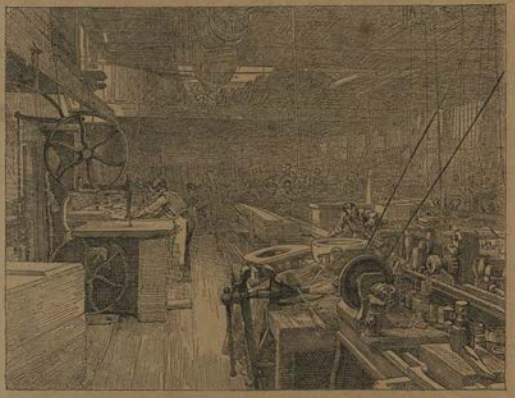
BATH-ROOM SUITE, EXHIBITED AND AWARDED GOLD MEDAL, HEALTH EXHIBITION, 1884.

where extension had ceased to be practicable. It was also interesting to observe the great variety of trades employed, comprising almost every branch of mechanical labour. In one part of the premises different descriptions of marble, and an immense quantity of slate in various stages of preparation, were being smoothed and sawn by machinery, shaped into slabs, and polished by a staff of masons and their assistants. In another department cabinet-makers were engaged in the preparation of casings, several of elaborate and beautiful design, intended, when completed and polished in an adjoining shop, to form the enclosures of lavatories and baths such as we had a better opportunity of inspecting in the show-room. Many of these were really splendid specimens of mechanical skill, the baths, in addition to the "Plunge," comprising every description of spray. The "Shower," "Douche," the "Wave," "Needle," or "Sitz," could be obtained at will, and at any required temperature, by a most simple arrangement of regulating valves provided for this purpose. The Romans, who were in the habit of bathing seven or eight times daily, would have needed no excuse for their indulgence had they been the fortunate possessors of such luxurious appliances as manufactured by Mr. George Jennings. But, returning to our inspection, we next passed by an external iron stairway to the upper floor of an adjacent building of still larger dimensions, known as "the Factory." Here a busy scene presented itself in the long lines of shafting, innumerable wheels and endless bands, all in rapid motion, working the lathes at which brass-finishers were occupied in the transformation of large quantities of brass and gun-metal castings (brought from the foundry on the ground floor of the premises)

FACTORY.

SMITHS' SHOP.

into valves, taps, and fittings of different kinds used in connexion with the various specialties of the Firm. Here, too, we had an opportunity of examining large numbers of W.C. apparatus, many of which were being specially prepared to fulfil orders from different quarters of the globe. Our attention was, however, attracted by the preponderance of the valve closet and trap formed in one piece of glazed porcelain, with which Mr. Jennings' name is so widely associated; and we were informed by a principal workman in this division, who has served the Firm for over thirty years, that more than 100,000 closets of this type alone have been tested and passed under his supervision. At the further end of the factory floor is the joiners' shop, with a mezzanine floor over



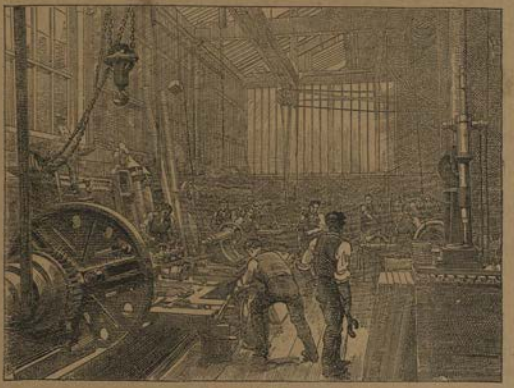
JOINERS' SHOP.

occupied by pattern-makers, while the entire length of the floor below is utilised as a store, full to overflowing with the thousands of pieces of earthenware constituting the stock patterns of the Firm. On the ground floor of the same building are the engineers' and machine shops, where, at the time of our visit, were being constructed several of those conveniences so conducive to public health, comfort, decency, and that we look for as a matter of course in the principal thoroughfares and open spaces of the Metropolis and larger provincial towns, and which we are glad to learn are now being similarly adopted in Continental and many Colonial cities. We next found ourselves amongst coppersmiths working, to the accompaniment of an untiring steam-hammer, upon

CABINET-MAKERS' SHOP.

number of those elaborate baths we have already described, and here we availed ourselves of the better

opportunity of observing the care and skill exercised in their construction before passing on to the smiths' shop; and then, noting by the way the well-appointed range of stabling, we were conducted through a large and convenient moulders' shop and the foundry, before referred to, taking the engine-room and boiler-house *en route*. This brought us to the packing department, where, as the last scene in the act, the fittings are carefully boxed and distributed, to see the light of day again in some remote corner of the earth.



ENGINEERS' SHOP.

The Firm do not, however, confine their attention alone to the production of fittings. A special and important branch of their business, and one for which they bear a high and well-deserved reputation, is to examine and report professionally upon the drainage, sanitary condition and arrangements generally, and water supply of buildings of all kinds, public and private, and to undertake their reconstruction when necessary. They also naturally prefer, when it can be so arranged, to fix their own specialties, for the satisfactory completion and continued efficient maintenance of which they are then prepared to guarantee for a term of years, a system the advantages of which appear to be fully recognised and appreciated. For such work a thoroughly capable staff of plumbers, hot-water fitters, and bricklayers skilled in drainage are retained, and the Firm are able to enumerate the principal hotels clubs, railway stations, theatres and public buildings, mansions, country seats and private residences in all parts of the kingdom and abroad, amongst the list of undertakings which bear substantial testimony to the excellence of their work.

MARBLE POLISHERS' SHOP.

The importance of the life-work of the late Mr. George Jennings cannot be over-estimated; and his sons, who now constitute the Firm, are able successors to this notable sanitary reformer.

Mr. Egerton Burnett, Wellington, Somerset.

AMONG the many changes of fashion brought about of late years by the growth of more cultivated tastes, none has been more remarkable than that which has led to the adoption of Serge to popular varieties of costume worn by both sexes. The transition has been, in some respects, a rapid one, and altogether for the better. Light and flexible woven substances, of elegant design, and embracing an infinite number of delicate shades, have taken the place of heavy and clumsy materials of rude patterns and pronounced colours. Pure wool fabrics are now manufactured of a degree of excellence, and with an effect formerly deemed impossible of attainment. The West of England has long had a high reputation for the quality of its Serges, and Somersetshire, in this respect, enjoys an equal share of fame with the sister county of Devon. Wellington, Somerset, is by name probably pretty generally known now throughout the world, because of its being the place in which Egerton Burnett's Royal Serge Warehouse is located. Whatever share of fame the town may have had in the making of its country's history, it may be content to resign it for the wider celebrity it has derived from this establishment. Of Egerton Burnett it may be said that he was, perhaps, one of the first woollen factors in the Kingdom to foresee the progress of feminine taste towards more artistic dress materials; and his close perception of cause and effect stimulated him to supply the means of satisfying an enlargement of ideas in this direction. It is, therefore, not surprising that, as the reward of commendable zeal and enterprise on his part, the fabrics which are identified with his name should have obtained the patronage of Royalty, and the high estimation of ladies of rank and fashion.

The Wellington Serge Warehouse, in the early days of its proprietor's crusade against crudities, consisted of two blocks of premises, and here the business was carried on for many years; but the growth of Mr. Burnett's trade rendered a larger building necessary, and a site known as "The Avenue" having been chosen, a new warehouse was erected. Considerable ceremony attended its opening early in this Jubilee Year, and an entertainment was given to several hundred guests. The card of invitation bore the following quaint and amusing inscription:—"An Evening's Diversion, to Keepe in Memorie ye Opening of Master Egerton Burnett's Newe Warehouse in ye Goode Towne of Wellington, will be provided therein on Tuesdaye, ye xv. of February, 1887, beginning at Eight of ye Clocke, when many of his Young Men and Maidens, and eke some Friends, will sing and also play upon divers Instruments of Musick, and otherwise entertaine ye Companie. Ye Doores will be opened halfe an houre before they do begin." The ticket was accompanied by an elegant little book, printed in old character upon hand-made paper, and bound with a silken ribbon. Herein "Ye Order of ye Performance (commonly now called—though in a foreign tongue—the Programme), of ye Pieces provided for the Diversion of ye Merrie Companie, which shall Assemble together in ye Great Upper Cloth Roome, at Eight of ye Clocke, on Tuesday evening, xv. February, in the Yere of Our Lord, 1887, to celebrate ye Building of *Master* Egerton Burnett's Newe Warehouse, in ye Good Towne of *Wellington*, in ye county of *Somersett*, and ye Names of those

who shall take part in the same, together with the Words of ye Songs (in case ye Singers shall not speak the words plainly)."

The artistic instincts of Mr. Egerton Burnett are elaborated in his fabrics, and those instincts he has further materialised in his model warehouse. Externally, it might be taken for a handsome private mansion; internally, its fittings and equipments are such as one would expect rather to find in an institute devoted to some phase of art culture, than in a building intended for ordinary purposes of business. The warehouse is of red brick, with Hamhill stone entrance and facings, is double-fronted, has two storeys, and stands in the best part of the town. The approach is through an iron gateway, on each side of which is a spacious lawn bounded by an ornamental railing. Passing over the threshold of the warehouse, access is had to a small vestibule with mosaic floor, and beyond this is a large entrance-hall, the floor of which is also inlaid with mosaics. Dividing the vestibule from the hall is a lofty partition, with some fine artistic work in stained glass, representative of various nationalities. In this partition are the principal entrance-doors. Immediately on the left of the entrance-

MR. EGERTON BURNETT.

hall is a reception-room, suitably furnished for customers and visitors, and leading therefrom is the proprietor's private office, which extends to the outer wall of the building. The windows of both these apartments are finished in stained glass, and overlook the front. Behind the reception-room and private office, and separated from them by a corridor, affording another means of entrance and exit, is a spacious machine-room, where the various materials are cut into patterns by a special machine. On the right of the entrance-hall is the general office, a large and lofty apartment, occupied by a staff of clerks, and adequately adapted to the requirements of business. It is nearly square in shape, and has six stained glass windows, three of which share the front outlook, the others being situated in the boundary wall on this side. A lift communicates with the floor above, for the conveyance of patterns, parcels, books, &c. Leading from the general office is the packing-room, wherein, as its name denotes, is carried on the packing of the various goods for dispatch to all parts of the world. Directly beyond this is the ware-room, the most important apartment, from a trade point of view, in the building. Here are to be seen ranged round the walls a large number of shelves, stocked with those varieties of material which the resources of Mr. Burnett's business can command, and for the supply of which customers of every degree and station may make application. Four wide counters stretch across the room, and facilitate the

duties of the assistants. Here it is that orders are actually executed, and the goods are passed hence to the packing-room. The length of the ware-room is sixty feet, and it and the packing-room—which is twenty feet long—together form one splendid apartment, having an extreme length of eighty feet, with a uniform breadth of thirty feet. The character and purposes of the six rooms on the ground-floor have now been shortly stated; but it should be mentioned as a noteworthy feature of embellishment, that the ceilings are, for the most part, composed of pitch-pine, the walls being lined with the same wood, and varnished throughout. Artificial illumination is supplied to the ware-room, when required, by means of ten patent gas-lights, so adapted that vitiation of the atmosphere is prevented, and the fumes carried off through exhaust-tubes. On the ground-floor are also a lavatory and a room for the storage of packing-paper, &c.

Returning to the entrance-hall, a wide staircase with ornamental baluster affords access to the top storey, where are five principal apartments. A large pattern-room commands the front view, having a situation on the left of the landing. The interior fittings of this fine room are of a kind similar to those already described, though somewhat more simple in detail. A number of women and girls find employment here in the classification and arrangement of patterns of materials, and the order and regularity with which the work is done is manifest, as is the case in every branch of this notable warehouse. Next to this apartment, and immediately opposite to the landing, is another pattern-room of smaller dimensions, which has also a front aspect. On the right of the staircase—at its summit and commanding the entire width of the building in this direction, with a party-wall, pitch-pined like the rest, dividing it from the smaller pattern-room and from the landing—is a large and lofty stock-room, which is provided with windows on two of its sides. Behind the principal pattern-room is situated the stationery department, wherein is kept a stock of the costly and unique artistic stationery of all descriptions, for which Mr. Burnett, by his creative fancy, has individualised himself in the prosecution of his trade. The noble stock-room adjoining has a length of eighty-five feet, with a proportionate width of thirty feet—dimensions exactly corresponding with those of the ware-room and packing-room, taken together, directly underneath. This stock-room is, in some respects, the handsomest apartment in the building. It receives its light from seven spacious windows, extending along one side, and is ceiled and lined throughout with varnished pitch-pine and deal. A lavatory is also on this floor. An even temperature is secured for the premises by a patented system of hot-water apparatus, and the ventilating and sanitary arrangements are on new and improved principles. In conceiving the plan of his new warehouse, Mr. Burnett generously decided to depend upon his own county for the requisite professional skill, and, therefore, instructed Mr. E. T. Howard, architect, of Wellington, to prepare designs, which, under Mr. Burnett's personal supervision, were carried out by Mr. H. J. Spiller, builder, of Taunton.

Mr. Burnett holds the Royal and Imperial warrant as "Court Merchant-in-Chief" to H.I. and R.H. the Crown Princess of Germany (Princess Royal of England). Among his most illustrious patrons are H.R.H. the Princess of Wales and her daughters, H.I. and R.H. the Duchess of Edinburgh, H.I.M. the Empress of Russia, H.M. the Queen of Italy, H.M. the Queen of Saxony, H.R.H. the Crown Princess of Denmark, H.R.H. the Princess Irene of Hesse, H.R.H. the Grand Duchess of Mecklenberg-Strelitz, and other members — princesses and princes — of the Imperial and Royal families of Europe, as well as many personages of distinguished rank connected with their courts. The Royal Serges, which have become so thoroughly associated with Mr. Burnett's name, are celebrated for the special intensity of the dye used in their manufacture, which renders them impervious to the influence of the sun or of salt water, and likewise for the absolute purity and fineness of the wool, by which a high standard is attained both in texture and finish. The Serges are made in qualities and strengths to suit all seasons and climates, and in almost any shade of colour. They are popular for nautical, sea-side, and general out-door wear. From the Wellington warehouse have also emanated an infinite variety of other artistic materials, both in wool and cotton, patterns of which are sent post-free to any part of the world.

The Wellington warehouse affords employment to a number of persons; and its proprietor has been naturally called upon to take a prominent part in the affairs of the town during the course of his long career of trade in its midst. Mr. Burnett was early appointed on the Jubilee Committee which was formed in Wellington for the purpose of establishing a local memorial in honour of Her Majesty's Fifty Years' Reign, in which he has worked with characteristic energy, and contributed greatly to the furtherance of that object.

Messrs. Palmer's Shipbuilding and Iron Company, Limited, Jarrow-on-Tyne.

EVIDENCE that the district of the Tyne was from an early period a highly-important Shipbuilding centre, is afforded by the fact that, writing more than a century and a-half ago, Defoe, in speaking of the Tyne, says:—"They build ships here to perfection,—I mean as to strength and firmness, and to bear the sea." Since this was written the world has moved at a marvellous pace, and in Shipbuilding more than in any other branch of National Industry progress has been made by leaps and bounds, and the vessels of to-day have no more resemblance to those of Defoe's days than has the "Flying Scotchman" express train in common with the cumbrous vehicles in use for travelling at the time when George II. ascended the throne—a date contemporary with that of the publication of Defoe's work from which the above sentence is quoted. In one respect, however, things remain now as they apparently were then. The River Tyne is still unequalled for its Shipbuilding industry, and neither on the Thames nor the Clyde is to be found a private Shipbuilding yard which at all approaches in extent or resources the establishment of Messrs. Palmer's Shipbuilding and Iron Company, to which we are about to draw attention.

Sir Charles Mark Palmer, Bart., M.P., the founder of the present Firm, has played a leading part in the introduction of Iron Shipbuilding. About the year 1850 the carriage of coal by railway began seriously to affect the sale of North Country coal in the London market, and it became, therefore, essential in the interest of coal-owners to devise some means by which the staple produce of the district could be conveyed to London in an expeditious, regular, and economical manner. To accomplish this object was the problem which Sir (then Mr.) Charles Palmer set himself, and with that end in view he designed an iron screw steamer, the *John Bowes*, which had a carrying capacity of 650 tons, and was capable of an average speed of nine miles per hour. To the success of this experiment, more than to anything else, is due the truly marvellous development of the Shipbuilding industry on the Tyne as well as elsewhere. The new departure met originally with much opposition; Mr. Palmer, however, felt confident of the result, and time has amply demonstrated the soundness of his theories and the wisdom of his plan. Nay, more, as illustrating the quality of the material and the excellence of the workmanship, embodied even in those early days in the vessels produced by the Firm, let it be placed upon record that the *John Bowes* is still doing as good service as it did when first launched, and yet thirty-five years have elapsed! As an appropriate corollary to the foregoing we may mention that the boilers, of 85 tons weight, made by Messrs. Palmer in 1870 for the ss. *Wisconsin*, also continue, after seventeen years' hard service, in as good working order as ever. Many other instances of a like character might be adduced redounding equally to the credit of the Firm; but let these two suffice.

The Shipbuilding yard was established in 1851, down to which time Jarrow was a mere pitman's village, inhabited by the small number of persons who were employed at a colliery in the neighbourhood

This colliery has long since been exhausted and filled up; and had it not been for Messrs. Palmer's wisely-directed enterprise, Jarrow would probably to-day have no existence in the commercial annals of this country. As it is, the place has become a flourishing town, with a population of over 30,000, and no one can pass through its streets without being impressed with the signs of prosperity which are manifested on every hand, and without acknowledging that Messrs. Palmer, by establishing here their works of unequalled extent, have conferred lasting blessings—physical and social—upon the working population of the Tyne district. What—looking at it from a broader point of view—their unaided efforts have done for the nation in enabling us to maintain our prestige as the greatest and best Shipbuilders in the world, and in increasing our means of defence by supplying to the Navy some of its finest and most powerful ironclads, it is the object of the following notes to bring into prominence.

The Firm's Works cover an area of nearly 100 acres, and have a river frontage of 4,000 feet, while the number of building slips available is fifteen. Accommodation for repairing purposes is also provided on a large scale, including, as it does, a graving dock, 440 feet long by 70 feet wide, and a slipway, 600 feet long, worked by hydraulic lifting gear. The bird's-eye view given on next page affords only a general idea of this gigantic establishment; for it is impossible to do justice, either by illustration or description, to the endless series of blast and smelting furnaces, workshops, yards, wharves, &c., which are here grouped together. To enable the reader to form some faint notion of what *is* implied by Palmer's Shipbuilding and Iron-Works, let us state that they include within themselves the entire range of operations, from the smelting of the ironstone to the complete equipment of iron vessels of all sizes. The ore itself, raised at the astounding rate of 1,000 tons per day, is brought round by sea from the Company's own mines at Port Mulgrave, near Whitby, in Yorkshire, and is lifted from the river wharf at the Works up to the railway level, along an inclined plane, worked by a stationary engine. Coke and coal are brought from Marley Hill and other collieries in Durham and Northumberland, by the Pontop and Jarrow Railway. The coke is discharged into a hopper, capable of holding about 1,500 tons, and the blast furnace barrows are filled through sliding doors; manual labour being thus entirely dispensed with. Each of the four blast furnaces here in operation is 85 feet high, of 24 feet diameter at the boshes, and from 8½ feet to 10 feet in the hearth. They are capable of producing together over 2,000 tons of pig iron per week, more than one-half of which quantity is used in the Company's Works. Taking the average, the production of pig iron amounts to nearly 100,000 tons per annum, and that of finished iron and steel to 55,000 tons. The blast is heated to about 1,500° Fahr. in eight "Whitwell" hot-air firebrick stoves, and there are eighteen kilns available for calcining the Cleveland ironstone.

The forges at work comprise eighty puddling furnaces, producing together over 1,000 tons of puddled bars weekly. There are two forge engines with 36-inch cylinders, one of 4-feet and the other of 5-feet stroke, each driving a roll train and four pairs of 22-inch rolls. Besides these, there are two plate mills and ten mill furnaces, with an output of about 1,200 tons of finished boiler and ship plates weekly. Each mill has two pairs of 24-inch rolls, reversed by clutch and crabs. We have further a bar mill, with two pairs of rolls driven by a 24-inch cylinder, which produces weekly 120 tons. A fourth mill, with four pairs of rolls, driven by two 30-inch cylinders, with 4-feet stroke, produces about 300 tons of plates per week. In addition to the above, there is a large angle and bar mill, driven by a single engine having a 36-inch cylinder and a 4-feet stroke, which is capable of rolling the very largest angles used in the trade; and there is also a sheet mill in the forge. Attached to the rolling mills are shears, circular saws, punching and straightening presses, and other appliances for the construction of iron and steel ships built on the river frontage of the Jarrow Works.

Prodigious as are the foregoing figures, they only relate to one section of this immense Shipbuilding yard. The adjoining department is devoted to the production of engines, and its manufacturing capacity may be judged from the fact that here can be finished from thirty to forty pairs of marine engines, with their boilers, in one year. This department, too, we may add, produces its own iron and brass castings and forgings, and is thus altogether self-contained. In the boiler shops vertical rolls for rolling long boiler shell plates were first used, and the original rolls may still be seen in operation. Allusion has been made to the productive capacity of this portion of the establishment; and that what we have said on this head is not mere theoretical assumption, may be inferred from the fact that in 1882–83 (June to June), thirty-six pairs of engines were turned out, of 7,300 nominal, and 39,240 indicated horse-power.

Next in order for mention comes the Shipbuilding department proper, which occupies the east end of the Company's works. It contains the largest graving dock on the coast, and also, amongst others, a very fine patent slip, lately fitted with hydraulic hauling gear. The building slips are suitable for every kind of

vessel up to 500 feet in length, and, together with those in the Howdon branch of the Works, on the opposite side of the river, are capable of launching 70,000 tons of shipping annually.

Let us adduce a few more figures which will demonstrate the unequalled productive capacity of Messrs. Palmer as Shipbuilders. In 1881, the output amounted to 48,000 tons of shipping. During the following year twenty-nine vessels were built, of an aggregate tonnage of 61,489 tons, or an average of 1,183 tons per week. Even these very high figures have, however, since been exceeded; the total output in the following year (1883) having been thirty-five vessels, representing a gross register tonnage of 62,000 tons, or the enormous average per week of about 1,308 tons. All these ships, be it remembered, have also been fitted with engines and boilers built at the Works.

As a matter of course, the British Navy has been largely dependent upon the resources of this gigantic establishment, no less than thirty-three vessels having been built there for our Government. The first of these, the *Terror*, was also the first iron ship for war purposes constructed in the Tyne district. It was built during the Russian War, having been intended to operate against Cronstadt, and was completed in little over three months. It was in the building of this vessel that rolled armour plates were first used,—a new

MESSRS. PALMER'S SHIPBUILDING YARD.

departure, to which the Admiralty at the time strongly objected, but which has since, like all other inventions and improvements introduced by Messrs. Palmer, amply demonstrated its great value; rolled armour plates having now almost universally replaced forged plates, by reason of their greater strength and general superiority. Next came the *Defence*, the first armour-clad ram built for our Government. This vessel was of the following dimensions: — length 280 feet, breadth 54 feet, and depth 26 feet, while her displacement was 6,070 tons. This was succeeded by the *Jumna*, troopship, length 360 feet, breadth 49 feet, depth 22 feet 4 inches, and displacement 5,500 tons; the *Cerberus*, length 225 feet, breadth 45 feet, depth 16 feet 6 inches, displacement 3,344 tons; the *Swiftsure* and *Triumph*, each of which measures, length 280 feet, breadth 55 feet, depth 25 feet 10 inches, and displacement 6,660 tons; the *Gorgon*, length 225 feet, breadth 45 feet, depth 16 feet 7 inches, and displacement 3,430 tons; the *Surprise* and *Alacrity*, each being 250 feet in length, 32 feet 6 inches in breadth, 18 feet 7 inches in depth, with a displacement of 1,400 tons, and engines of 3,000 indicated horse-power. Only quite lately there have been further added to the Navy the *Orlando* and *Undaunted*, belted, swift cruisers, each measuring in length 300 feet, in breadth 56 feet, in depth 37 feet, and having a displacement of 5,000 tons. The indicated horse-power of these two magnificent ships of war is 8,500 horse each, while they make the very high speed of nineteen knots per hour. Not included in the above list are twelve gun-boats of the *Medina* type, built by Messrs. Palmer for our Navy, each of which measures, length 110 feet, breadth 34 feet, depth 9 feet 6 inches,

and displacement 363 tons. In order to complete this record we must add ten torpedo vessels, each of which has a length of 65 feet, a breadth of 15 feet, a depth of 8 feet 2 inches, and engines of 120 indicated horse-power. For many of the above ships the engines, too, were built at the Jarrow Works.

Thus far we have dealt only with war-ships; and were we to enumerate the many magnificent merchant vessels built by the Firm, the record would be one of far greater length than the above, and would encroach upon more space than is at our disposal. In order, however, not to shelve this branch of the subject entirely, we have tabulated below the names and size of such vessels only as exceed in length 350 feet:—

Name.	Length.	Breadth.	Depth.	Displacement.	Indicated Horse-power.
	Feet.	Feet.	Feet.	Tons.	
Erin	370·4	41·1	28·1	3,318·69	1,400
Ontario	370·8	41·15	28·1	3,314·89	1,400
Helvetia	371·5	41·2	28·1	3,318·73	1,400
Scotland	382	43·2	28·8	3,698·79	1,800
England	357·5	42	27·8	3,307·64	1,800
Nebraska	367·5	42·3	35·3	3,984·71	2,200
Wisconsin	366	43·2	26·6	3,219·94	2,900
Wyoming	366	43	26	3,219	2,900
Montana	400·4	43·7	37·7	4,330	3,400
Dacota	400·4	43·7	37·7	4,330	3,400
Whampoa	399·5	42·2	28·4	3,834·69	2,100
Virginian	422·2	40·95	28·95	4,081·24	2,500
Venetian	422·2	40·95	28·95	4,081·24	2,500
China	399·5	44·85	31·15	4,500	3,500
Raffaele Rubattino	399·5	44·85	31·15	4,500	3,500

Largely instrumental as were Messrs. Palmer in the more general adoption of iron for Shipbuilding purposes (as pointed out earlier in this article), they have ever since spared no effort to keep abreast of the times, and recognising the value and increasing importance of steel for the same purpose, they fitted up two years ago large Steel Works to the south of their rolling-mills. The machinery provided for this department is of the most massive description and of the latest approved type. There are a number of patent open-hearth gas-furnaces, on the Batho system, each holding eighteen tons of steel. The shears provided are capable of operating upon blooms or slabs of 30 inches wide by 9 inches thick, hydraulic apparatus being available for regulating the exact length of metal to be cut. The cogging-mill for reducing ingots up to five tons in weight is probably, without exception, the finest in Europe. The engines supplying the motive power for this department weigh over 200 tons, and are capable of working up to 6,000 indicated horse-power. But it would take us too long to describe all the powerful and complicated machinery laid down in connexion with the manufacture of steel. We may state briefly that the plant is throughout of the most effective character, and such as is not surpassed in any other Works of a similar character throughout the Kingdom. Not only do the Company manufacture the steel for their own requirements, but they also supply it largely to other shipbuilders, by adopting which highly liberal course they enable other Firms to compete with the Company on equal terms.

How marvellously the shipping trade of this country has developed since Messrs. Palmer's business was started, let the following figures attest:—In 1850—the year before these Works were started—the aggregate tonnage of British shipping amounted to 3,565,133 tons; whereas the corresponding figures at the end of the year 1885 show a registered total of 7,430,045 tons, thus giving an increase during the period in question of considerably more than one hundred per cent.! We may confidently assert that the energy, enterprise, and business aptitude of Messrs. Palmer have proved one of the most powerful factors in bringing about a rate of development which enables us to boast that both the amount of our shipping and its general efficiency are without parallel in the whole history of the world.

It will be well, in conclusion, to establish our assertion that the Company under notice stands out pre-eminent from all its competitors. We will do so by the aid of a few statistics, which, incredible as they may seem, are nevertheless authentic and trustworthy. The Jarrow Works are the largest and busiest of any private shipbuilding-yard in existence; and although some of our own Government dockyards are larger in area, they can none of them—neither Chatham, Devonport, nor even Portsmouth—compare with the Works in

question for the extent of the operations carried on; for whereas Portsmouth employs about 5,000 persons, Palmer's Shipbuilding Company has a working staff of 7,000 hands! The wages paid by the Company during the seven years, 1878–1884, represent the fabulous amount of £2,795,038, a sum nearly equal to the whole revenue of the Kingdom of Denmark. The work produced during this period included 292,435 tons of shipping, in addition to engines having an aggregate power of 149,648 horse; the value of the total production being computed at about £9,000,000 sterling. It is, of course, difficult for the mind to grasp the import of these figures, and it may lead to a better apprehension if we put it in another way. During a single year (1883) there was paid in wages the sum of £535,288, giving an average per week of £10,294. Here again, for purposes of comparison, it is worth emphasising that this total is £100,000 in advance of the amount of wages paid during the same twelvemonth at Portsmouth, which is the largest of our national dockyards. Need we add that the output of shipping alone at Messrs. Palmer's yard was correspondingly in advance of the Government establishment, not to mention thirty-five marine engines which were constructed by them in the same year. How largely the Palmer Company is ahead of other private shipbuilding Firms, will appear from this, that during the seven years under notice they have produced work representing a value of £3,000,000, and paid in wages £1,000,000 more than any other Firm of shipbuilders. This fact becomes quite as strongly accentuated from another point of view. During the fourteen years ended December, 1884, they have built 278 vessels, being about 100 more than had been launched of the same size by any other Firm.

An order which had been just completed at the time of our visit to Messrs. Palmer's Shipbuilding yard, was the building of four screw barges, each of 500 tons displacement, to be used in connexion with the construction of the Panama Canal, for carrying out to sea the earth dredged from the canal. These barges had been completed throughout in the short space of three months. There was also in hand at the same time the second of the two twin-screw belted cruisers built for our Navy, to the first one of which, already completed, reference has been made on a preceding page. These two kinds of vessels well illustrate the scope of the Firm's business, which ranges from the smallest pleasure yacht or steam barge to the largest of merchantmen or ironclads, and we must leave to the reader's imagination to fill in the long range and variety of vessels which separate these two extremes, and typical examples of each of which classes have at some time or other been built here.

Ever since the Firm was converted into a Company in the year 1865, Sir Charles M. Palmer, M.P., has continued to preside over the concern as Chairman, he being also the largest shareholder. His eminent services to the community have not failed of recognition. Sir C. M. Palmer, who was created a Baronet in 1886, is a Magistrate and Deputy-Lieutenant of the North Riding of Yorkshire and of the county of Durham; he is an Alderman and Magistrate of the Borough of Jarrow, of which town he was the first Mayor after its incorporation, and is a Lieutenant-Colonel of the 1st Newcastle and Durham Engineer Volunteers, and President of the Newcastle Chamber of Commerce. He has had a seat in Parliament since 1874.

Having thus given, as briefly as the importance of the subject permits, an outline of the business, it only remains for us to point out the marvellous development and continued prosperity of the Company. We may recall the fact that, as recently as 1873, these Works only gave employment to 4,500 persons, which number of operatives has been since increased to 7,000. The quantity and quality of the work done have advanced in even greater ratio, and Palmer's Shipbuilding and Iron Company has become the largest and most important Shipbuilding Firm in the world; but what is more, it has also established an unequalled reputation for the quality of its work. In this connexion we may mention that since April, 1876, Mr. John Price has been the General Manager of the concern. In order to appreciate what the management of such a business as that under notice means, let it be remembered that no instrument of human construction and contrivance represents such a concentration and variety of labour as a ship, and more especially a steamship. It is in this branch that British ascendancy is more remarkable and emphasised than in any other, and it is by the aid of such Firms as that under notice that we have gained our universally-acknowledged supremacy. The future conjured up long ago by the poet's imagination in the following lines has indeed been realised in our own days:—

> The time shall come, when, free as seas or wind,
> Unbounded Tyne shall flow for all mankind;
> Whole nations enter with each swelling tide,
> And seas but join the regions they divide;
> Earth's distant ends our glory shall behold,
> And the new world launch forth to seek the old.

Messrs. T. Walker & Son, Birmingham.

PROGRESSIVE improvements in connexion with the rigging and equipment of ships have been some of the many industrial characteristics of the last half-century. Owing to the marvellous rate at which Navigation has been developed within our own time, it has become a matter of the utmost importance to have instruments for correctly ascertaining the rate of speed at which a vessel may be going. Until the beginning of the present century no practical method was available for ascertaining the actual distance run by a ship. The hand-log then in use gave very uncertain results, and as a method of measurement it was altogether untrustworthy, for a heavy sea would sometimes throw the log after the ship, while a head sea would carry it in an opposite direction. In 1804 Edward Massey invented the so-called "perpetual log," which was composed of a bulky registering apparatus indicating the revolutions of a rotator or screw attached to it by a rope six feet long, the whole being towed behind the vessel by means of a line measuring 30 or 40 fathoms. This arrangement maintained its position during nearly two generations.

Massey also invented a sounding machine, to measure the descent of a deep-sea lead, but although superior to any pre-existent method, it was nevertheless found defective in use. Its mechanism was liable to injury when being hauled in, while the apparatus had moreover a tendency to sink out of the vertical line. The object of the present article is to show how, and by whom, these serious drawbacks were overcome.

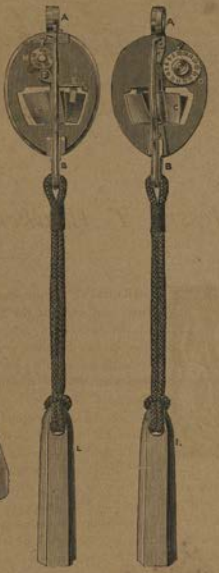
Mr. Thomas Walker, the founder of the Firm of Thomas Walker & Son, 58, Oxford Street, Birmingham, served his apprenticeship under Edward Massey (who was his uncle on his mother's side), and in 1837, the year memorable as that of Her Majesty's accession, removed to Birmingham. Here he started the manufacture of ship-logs and sounding machines, which instruments he made in the first instance for the eldest sons of Edward Massey, and thus originated what is now the largest establishment for these nautical utilities in the world. In 1861 Mr. Thomas Walker, in conjunction with his son, also Mr. Thomas F. Walker, the present head of the Firm, invented their famous A1 Patent Harpoon Ship-Log and the Harpoon Sounding Machine, both of which clever inventions are now known all over the civilised world. These instruments were made in the most compact and effective forms, the Harpoon Log being constructed with the revolving screw close up to the register, in such a manner that the pressure of the water against the front end of the rotator was entirely removed, by which means a serious obstacle in the way of correct registration at high speeds was removed, while, at the same time, the bulk of the instrument was considerably reduced, and with it the difficulty of towing and hauling in. As indicative of the high and almost universal appreciation in which these ingenious inventions were held, we may mention that, very shortly after their introduction, nearly the whole of the Log and Sounding-machine making trade was practically transferred into the hands of Messrs. Walker & Son. We illustrate on the next page various types of Ship-Logs and Sounding Machines, which will help to bring home to the reader the great improvements made by the Firm under notice.

In addition to this form of Harpoon Log, the Firm subsequently constructed one in which the whole of the instrument—register and rotator alike—revolves on a spindle held fast by the towing-line. This form, known

FIG. 1. MASSEY'S SHIP-LOG.

FIG. 2. WALKER'S PATENT A 1 HARPOON SHIP-LOG.

FIG. 3. WALKER'S PATENT A 2 HARPOON SHIP-LOG.



FIGS. 4 & 5. WALKER'S PATENT HARPOON SOUNDING MACHINE.

FIG. 8. WALKER'S PATENT ROCKET SHIP-LOG.

FIG. 6. MASSEY'S SOUNDING MACHINE.

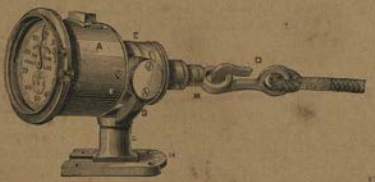


FIG. 7. WALKER'S PATENT "CHERUB" SHIP-LOG.

as the "A 2 Harpoon Ship-Log," was found to be admirably adapted for steamers going at a rapid and approximately uniform rate. For sailing vessels, however, the "A 1" form has always maintained its supremacy,

since its construction insures its travelling horizontally at slow speeds. When the patent expired, the manufacture of these instruments was of course thrown open, and many rival makers turned their attention to the production of similar logs, with, however, but very indifferent success. The accuracy of Walker's logs, which is due to the constant and untiring personal supervision of the head of the Firm, has insured for them an undisputed supremacy; of which circumstance, unscrupulous competitors have taken advantage by marking their own inferior goods with the name and trade-mark of Messrs. Walker & Son. The Firm do their utmost to check and expose such flagrant deceptions; but, seeing that their ship logs are in as great demand abroad as at home, it is often a matter of great difficulty to bring this fraud home to those who lend themselves to such malpractices.

Stimulated by past success, Mr. T. F. Walker a few years ago invented and patented the "Cherub Ship-Log," which is now as widely known as the Harpoon Log. This latest invention is a marvellous contrivance, and any one examining its mechanism cannot but be impressed, as we were ourselves, with the thoughtfulness, the ingenuity, and the skill which it embodies. In the "Cherub" Log the registering apparatus is fixed on the taffrail, the rotator being in the water attached to a long line, the inboard end of which actuates the mechanism of the register. This mechanism includes a bell which is made to sound six times during the passage of every mile. This form of log has the great advantage that by it the "present speed" of the vessel can be ascertained at any moment, while, at the same time, the total distance travelled is recorded on the dial, which, being on deck, is always readily accessible. Although the rotator of this instrument has to transmit its revolutions through a rope nearly 300 feet in length, the accuracy is such that cases have occurred where, in a total distance of nearly 6,000 miles, the log has registered within thirty or forty miles of the true distance.

For the last thirty years the Firm have supplied the English Admiralty with their various logs and sounding machines. The "Cherub" type is, however, deservedly replacing every other description, and it is already being utilised by Her Majesty's Hydrographer for coast-surveying purposes, for which it is admirably adapted, as, by the addition of a dial registering tenths of a mile, distances from point to point can be readily obtained.

Some fifteen years ago Messrs. Walker & Son bought the various businesses carried on by Messrs. Edward, Edmund, and Thomas Massey, of London, the three eldest sons of the Edward Massey before referred to, and the Firm have since made the several kinds of logs and sounding machines known by the name of "Massey." The demand for these has, however, considerably decreased since the introduction of Mr. Walker's far more perfect contrivances before described, the great superiority of which is recognised by all practical men.

The present head of the Firm, Mr. T. F. Walker, who is a member of the Institute of Mechanical Engineers, gained much valuable experience at the Paris Conservatoire des Arts et Métiers. Among other things, he made exhaustive experiments on the great variety of machines exhibited at the Paris International Exhibition of 1855. This training has proved of much value in the manufacture of nautical instruments, since Mr. Walker himself not only invents and improves these indispensable adjuncts, but, moreover, personally supervises all experiments and tests as to accuracy, his primary desire having ever been to maintain the high reputation which has been acquired for the perfect workmanship, best quality of material, and correct working of his ship-logs and sounding machines.

The extensive Works in Oxford Street, Birmingham, were specially built for the business some twenty-five years ago, and, in consequence of increasing requirements, they have been lately considerably enlarged. They are fitted up in every department with the most improved appliances. Many of the elaborate machines, contrived to work to mathematical accuracy, are the invention of the Firm, and the visitor sees strong proof on every hand that no effort is spared throughout the Works to insure perfection in every detail. Under the present able and active management, the fame of the Firm cannot fail to increase and extend, and Messrs. Walker & Son's name will ever be associated with some of the greatest inventions and improvements which have been made in those indispensable adjuncts of Navigation—Ship-Logs and Sounding Machines.

Various other cognate classes of goods are also made by the Firm, of which for want of space we can but name a few, viz., steam gauges; low-water alarms for steam boilers; detaching-hooks for the prevention of overwinding in mines; self-regulating vulcanisers for maintaining a steady heat for any length of time, &c. In addition to the above a large business is done in magnetic machines and needles for the mariner's compass.

Messrs. W. J. Barron & Sons, London.

ELSEWHERE in this volume will be found a description of the boot and shoe manufacturing business, as conducted in a large London factory; we give here some account of a trade which supplies the shoe manufacturer with sundry requisites, a trade, be it mentioned, which during the present reign has not only sprung into existence but grown into an important industry. To form anything like a correct estimate of its magnitude, one should bear in mind that over 100,000,000 pairs of boots and shoes are taken every year by our home and colonial markets; and also it should be remembered what a variety of materials the shoe manufacturer requires, including articles so diverse in character as leather and elastic webs, tingles, sewing threads, eyelets, rivets, laces, and buttons. In addition, moreover, to the lengthy and heterogeneous list of requisites for the manufacture of boots and shoes, there are goods of various descriptions which the retail dealer must always keep in stock, although not actually forming part of a shoe or a boot—such, for instance, as cork-socks, blacking, dubbin, and the like. To supply each and all of these wants of the boot and shoe trade is the special province of the shoe mercer; and the oldest business of the kind, as well, probably, as the largest, is that of Messrs. W. J. Barron & Sons, of whose London premises we give an illustration.

In the very heart of the City of London, and in the busy thoroughfare of Whitecross Street, the Firm of Messrs. W. J. Barron & Sons occupy an extensive warehouse and factory, known as the Eagle Shoe Mercery Works. The principal building, which covers a large area, comprises five floors, all of which are either closely stored with the articles required by the makers and sellers of boots, or else fitted up with the machinery necessary for turning out such articles. It is chiefly the smaller class of goods that are here dealt with; for, although the Firm deal largely in leather, that branch of their trade is mostly an export one, and is, therefore, conducted at other establishments with which they are connected. Besides the head-quarters in Whitecross Street, which extend into Silk Street and Chapel Street, there are branches of the business in Portland Square, Moor Street, Birmingham; in Midland Road, Wellingborough; in Bristol, and in Paris.

In the year 1839, two years after the Queen's accession, this business was founded by Mr. W. J. Barron, who commenced by making the galloons then in use for binding boots and shoes. Gradually he added other classes of goods, which had previously formed distinct trades, to the list of articles he dealt in, until his establishment became an important store from which bootmakers could supply all their wants. Thanks to his practical knowledge, Mr. Barron was able, at the early stage of the introduction of elastic side boots, to establish a manufactory of elastic webs, thus taking the lead in bringing about this important improvement in the art of bootmaking. The new style of boot was quickly appreciated by the public, and rapidly grew in favour; and, consequently, large quantities of elastic web were soon demanded. While helping, therefore, to confer a boon on the public, he was not a loser but a gainer by this new venture; the manufactory

proved highly successful. It would have been impossible for the business to have grown to its present proportions, had Mr. Barron been single-handed all his life; but, in course of time, his sons attained an age at which they could render valuable assistance, and he was then able still further to increase the scale of his operations. His business before long extended, not only to the continental markets, but to those of America, Canada, and the Australian Colonies; indeed, the Firm of W. J. Barron & Sons has become well known wherever there are large centres of boot manufacturing. As we have said, their export trade includes leather as being the essential part of a boot; and thus, while they purposely abstain from dealing in boots and shoes themselves, they supply the world with every requisite for this important branch of manufacture.

At the Eagle Shoe Mercery Works can be seen the process of making the rivets, eyelets, and tingles so extensively used in the shoe trade. The work is done by long rows of small machines, of the most improved construction, which first cut the brass wire for the rivets and the strips of iron for the tingles, into proper lengths and widths, and then automatically punch the points and heads. It is well to remark in passing that Messrs. Barron strongly recommend both brass tingles and brass rivets in preference to iron

MESSRS. W. J. BARRON AND SONS' MANUFACTORY, LONDON.

ones. The method by which the eyelets for lace-boots are produced is highly ingenious. By means of automatic machinery, long strips of thin sheet brass are passed beneath an apparatus somewhat resembling a steam-hammer. Instead of a plain block, however, the apparatus is fitted with a set of punches and dies, which stamp the brass, as far as it can safely be stamped in a cold state, into the shape of the eyelets. The strip of brass is then annealed, in order to enable a deeper impression to be safely stamped; and, by repeating the whole operation several times, the exact shape of the eyelets is finally impressed on the metal. The work, however, is not yet finished; for the eyelets must have the rough edges taken off and be rendered white, yellow, or fast black, as the case may be. The process by which the white ones are silvered and the yellow cleaned is particularly interesting; but it would be going too much into detail to describe it here. Immense quantities of leather laces are manufactured on the premises in every variety of style, and also immense quantities of cork socks of different makes. From sheets of cork and felt the most usual sizes of cork socks are cut out, several at a time, by an eccentric press worked by steam, while girls seated before sewing-machines deftly stitch round the edge of each sock in an almost incredibly short time. The sorting and making-up rooms are among the most interesting in the establishment. Here

may be seen a number of girls busily engaged in weighing and packing the rivets, eyelets, and other articles, or in carefully sorting over the goods that no "waste" may by any chance be sent out to the disadvantage of customers. It is worth while also to notice what a variety of labels in different languages must always be kept in stock.

Naturally, in a business which comprises so great a diversity of technical materials, some only of the goods they deal in are manufactured by Messrs. Barron & Sons themselves. To produce within the walls of a single factory all the different articles which the boot and shoe trade demands would obviously be an impossibility. But Messrs. Barron are scrupulously careful that their stock shall not be wanting in whatever the trade requires. Their emporium in Whitecross Street may be described as being, to the manufacturer or seller of boots, what the "general store" is to the settler on the American prairies—a place where each and all of his wants can be supplied. Observing how extensively various dressings and blackings have come into use in the homes of the well-to-do, they have now become large dealers in these goods, and act as agents for the New Military Blacking Company: besides the ordinary blacking that polishes by brushing, this Company manufacture also the Empress Gloss for ladies' boots, and the Indian Waterproof Blacking for gentlemen's, neither of which requires to be brushed. And as if still further to be identified with the manufacturers of boots and shoes, although not themselves makers of those goods, the Firm under notice have quite lately been instrumental in introducing to the trade a marvel of simplicity and ingenuity, in the shape of a new bootmaking process, and are manufacturing the new nails required in the same. This is patented by Messrs. M. L. Lion and F. Cutlan, and will, it is believed, produce the cheapest and most elegant boot ever yet made. A company has been formed to work it, called the Ab-Intra Boot Making Process Company.

In 1877 the Whitecross Street warehouse and factory was erected, and the business removed from Aldermanbury, where it had been conducted for the previous thirty-eight years. Two years later, Mr. W. J. Barron retired, and left his eldest son, Mr. Edmund Charles Barron, at the head of the house. We must not omit to mention that the Firm were the recipients of a Silver Medal at the Paris Exhibition of 1878, and have distinguished themselves generally at the Trades Exhibitions in London and Glasgow; nor must we forget to state that it was Mr. W. J. Barron, in conjunction Mr. J. S. Deed and others, who originated the Shoe Mercery Pension Society, now known by the altered title of the Leather Trades Benevolent Institution.

Messrs. Elkington & Co., Birmingham.

GREAT Inventions deserve, undoubtedly, to be ranked among the foremost achievements of mankind, for the benefits they confer generally extend to all nations. This fact seems to have been recognised even in antiquity, when divine honours were attributed to inventors. Nor need this surprise us when we consider for a moment that to inventors we owe, to a greater or less extent, many, if not most, of the necessaries, comforts, pleasures, and luxuries of life. In the list of such benefactors to mankind must be included the name of the late Mr. G. R. Elkington, the founder not only of the business now carried on by his sons, who constitute the present Firm of Elkington & Co., but also the inventor of a new process, and the originator of a new branch of Art-Industry which has contributed very materially to the progress and prosperity of Birmingham as well as other towns, and has been no less potent a factor in the beautifying of our homes.

In these days of refinement, when due importance is attached to the appointments of a dinner-table—when we are accustomed to the pure forms and tasteful ornament of electro-plate side dishes, salvers, cruet-stands, and similar accessories, and when all these articles are brought within the means of even the moderately well-to-do—it is perhaps not easy to realise that things were not always thus. And yet, until Mr. Elkington set his brain to work, and as the result of long-protracted and often disheartening experiments introduced the manufacture of Electro-plated Ware, a very different state of affairs obtained. Before this time the art of attaching a surface of precious metal to the baser metals consisted in soldering a plate of gold or silver upon a thicker plate or bar of copper, and then submitting the compound mass to the rolling process Mouldings and chasings were, on the other hand, made solid, or stamped hollow in the precious metal, and filled with some baser fusible metal. Under the old process, all ornamental work was produced by the die-sinker. The foliage intended for ornament was clumsy, and the stems and leaves were heavy and shapeless. As a necessary consequence, the work produced was of a most bizarre and commonplace character, devoid of all artistic feeling, and as poor in conception as in execution. That under such circumstances the demand for this kind of ware was but small is not surprising, especially when it is remembered that the goods were, moreover, very dear.

Thus things had gone on for many years in the old, unsatisfactory way, when Mr. Elkington came upon the scene. He it was who realised that, by the agency of electricity, the gold or silver plating might become one substance with the baser material on which it was deposited, instead of being a mere covering, as applied by the old and tedious process. Until then, copper and similar metals had been used as a base; but Mr. Elkington struck out a new departure, and substituted a whiter and harder metal in the form of German silver. According to the old method the smoothing, finishing, &c., had all to be done after the article had been coated with silver. This had its undoubted disadvantages, and here, too, a reform was wrought; for, in the production of Plated

Ware, the electro-deposition is now one of the final processes, after all the various repairs and minor operations have been completed.

Success did not, however, come all at once; for difficulties continued to present themselves almost constantly for some years. Occasionally, after the article had been exposed in the bath, the silver deposit would rise in blisters, or peel off altogether when the burnishing tool was applied. At other times the metal assumed objectionable colours, and thus the patience and energy of the inventor were sorely tried. By degrees, however, all technical difficulties were overcome; and, what is more, improvement followed upon improvement, until now the most magnificent works of art can be, and are, produced by the aid of Electro-plating at the Newhall Street Works, Birmingham.

Some twenty years ago Messrs. Elkington & Co. gave employment to 500 workpeople, while the number of employés at the present time is no less than 2,000. Proportionately great has been the increase in the quantity of goods produced, and, moreover, the artistic development of the articles manufactured may be said

to have more than kept pace with the growth of the business. At the Newhall Works there is now made every variety of Silver and Electro-plate Ware, including épergnes, vases, presentation cups, candelabra, tea and coffee services, ornaments of all kinds, and table ware generally.

In the several workshops the visitor can watch the progressive steps by which the crude raw material is transformed into the elegant, finished article in all its rich brilliancy. The processes of manufacture are rather too numerous and intricate to allow of detailed description; we shall, therefore, content ourselves with giving a general outline of the *modus operandi*. As already mentioned, the raw material employed is German silver. The metal having been rolled, and cut into blanks, the first process that follows is the shaping. If for flat work, stamping is had recourse to, while hollow ware is shaped by a somewhat more elaborate process. Stamps worked by hydraulic power are used for dish-covers and similar large articles. Another process, technically known as "drafting," consists in beating out by hand flat pieces of metal, and passing them on from smaller to larger moulds, until the desired dimensions are attained. The number of steel dies in stock illustrates the diversity of goods produced and the varying character of the patterns, there being altogether more than

60,000, which, computing them at the moderate sum of ten shillings each, represents a money value of £30,000! "Spinning" is the process adopted in the production of hollow ware, such as coffee and tea services. A block of wood, called a "chuck," of the desired shape, is mounted in a lathe, and the metal is then placed upon the wood, and, by the aid of suitable tools, is gradually made to assume the desired shape. "Beading" and "piercing" are the next processes. The former consists in raising the beaded pattern on the edges of waiters and trays, while piercing implies the cutting-out of patterns on certain articles, such, for instance, as cruets.

The above processes relate, of course, mainly to the production of large works. To go into detail concerning the manufacture of the hundreds of minor accessories required to complete the different articles is beyond our purpose. After the various parts have been fitted together, they are inserted into the voltaic bath, and here, like everywhere else, great pains have to be taken, and the utmost vigilance has to be exercised to insure a substantial coating or plating of the metal and a uniform colour. The polishing or burnishing constitutes the final stage of the work.

Among the processes of enrichment that are pressed into service for Silver or Electro-plate Ware are engraving by hand and enamelling, in both of which branches Messrs. Elkington excel, as is attested by the marvellous specimens of such work which have been produced at their factory.

In the production of Gilt work the same processes are, as a rule, followed as those adopted for electro-plate, with the exception, of course, that gold is used for the bath. To the uninitiated, it is difficult to convey even a faint idea of how much of the future success of the work depends upon each separate step, and even upon what might appear subsidiary processes. Such is, however, the fact, and the quality of the articles here turned out is guaranteed by the painstaking care with which every stage is watched, and the rigorous insistance upon the highest standard of workmanship and finish in each department.

Bronze Casting is yet another branch of the Firm's business. Much of the work produced may challenge comparison with that of the most advanced foreign manufacturers. From among the statues that have been here cast we enumerate a few:—Three equestrian statues of the late Prince Consort, 13 ft. high, modelled by Thorneycroft, and erected respectively in Liverpool, Wolverhampton, and Halifax; the Guards' Memorial, 9 ft. high, and a figure of "Victory," 10 ft. 6 in. high, modelled by John Bell, and set up in Pall Mall, London.

It was a happy inspiration which prompted the son of Sir Christopher Wren to place over the tomb of his father the memorable words: *Si monumentum requiris circumspice!* Similarly we would say to any one who may wish for demonstrable evidence of Messrs. Elkington's special talent as bronzefounders: "Look around," for in Birmingham itself, near New Street Station, can be seen a fine statue of Sir Robert Peel, 7 ft. high, modelled by Mr. P. Hollins, which was cast by the Firm under notice; while other similar works are to be found in many different towns of the kingdom, as well as in India and elsewhere. As related to the last-mentioned branch, we may state that the Firm have also reproduced, by the aid of bronze deposition, some of the choicer works of antiquity, and these facsimiles are scarcely distinguishable from the originals.

Some notion of the class of art-work produced at the Newhall Factory may be formed from the accompanying illustrations, which, excellent as they are, cannot, of course, reproduce the charm of detail, the elaborateness of finish, and the effective brilliancy of the originals. To do justice to these qualities one must visit the Show-rooms attached to the Works, or the branch establishments in Regent Street and Moorgate Street, London, Liverpool, Manchester, and Sydney, N.S.W., all of which are filled with a magnificent assemblage of Silver and Electro-plated goods, adapted alike for domestic use and presentation purposes. The gorgeousness of

ENTRANCE TO THE SHOW-ROOM.

the thousand and one articles here shown beggars description. Messrs. Elkington's business has thus done much to foster and cultivate Art, and to educate the public to an appreciation of the beautiful. Their productions find a market among the art-loving people of both the mother-country and her Colonial possessions. Her Majesty the Queen, as well as other members of the Royal Family, have extended their patronage to this Firm; and there are few residences of any pretension where specimens may not be seen on the sideboard or dinner-table. The jurors at different International Exhibitions have also endorsed the general admiration for these works of art by awarding high distinctions, and, as in the case of the jurors of the 1862 Exhibition, expressing their appreciation of the "enterprise and liberality" of the Firm; while many of the productions here called into being may be said to have a world-wide and even an historical reputation,—such, for instance, as the Elcho Shield.

For the various reasons set forth in the course of this article, Messrs. Elkington & Co. deserve an honoured place in this ALBUM OF ARTS AND INDUSTRIES; and there is, further, an exceptional appropriateness in this, by reason that they themselves have also lately celebrated the jubilee of their existence, for it was in the year 1836 that the business under notice was established, and since then it has grown and increased until to-day it occupies a position of pre-eminence. Not only is the workmanship of past ages here reproduced as if by magic, but here, too, are called into existence the more modern "master thoughts and master touches of artistic genius in designs of infinite variety."

Messrs. Edward Cook & Co., Bow, London.

PRACTICAL applications of the science of chemistry are very imperfectly understood by the majority of mankind. When a new discovery is made in the laboratory, it is accepted and utilised by the general public with comparative indifference, and little or no thought is bestowed upon the patient workers who devote their lives to the study of nature, extorting treasures from the earth and rendering hurtful compounds into harmless and valuable products, many of which prove incalculable boons to civilised beings. Some of the alchemists of the Middle Ages believed heart and soul that gold could be made, and that by long search or close study they could find the philosopher's stone. Many of these men were knaves, who had wits enough to perceive that the search was futile, and impudence enough to dupe more credulous people than themselves, and wheedle their fortunes out of them on pretence of returning them more than tenfold in the shape of a recipe for the conversion of lead into gold. Such characters abounded during the Middle Ages, and found easy dupes, whom they deceived by the most shallow tricks, such as placing a piece of gold in the crucible of transmutation, together with valuable substances, and after many processes and much heating, showing the little button of metal which had all along been present. Of the true alchemist we have many pictures. The alchemist, the astrologer, the mystic, the wizard, were men of the same stamp; they often practised the same arts side by side. The same attitude of thought belonged to them all, and became all equally well. Take the dreamy, maudlin, semi-maniacal Althotas, who has been described so well by Dumas:—"An old man with grey eyes, a hooked nose, and trembling but busy hands. He was half buried in a great chair, and turned with his right hand the leaves of a parchment manuscript." Note also his intense abstraction, his forgetfulness of the hour, the day, the year, the age, the country—his absolute and intense selfishness and absorption, the concentration of the whole powers of his soul upon his one object. These were the men who in their search for the stone which was to transmute the baser metals into gold laid the foundation of experimental chemistry; but it must not be supposed by the unscientific reader that the modern chemist resembles in any particular the alchemist of the Middle Ages. The peculiar secret and mystical language which the alchemists adopted was intended to prevent the vulgar from acquiring the results of their long-continued labours. The obscurity of the science was increased by the multiplication of symbols, and various artful means were employed in order to keep all scientific knowledge to themselves.

Paracelsus, who died in the sixteenth century, helped to withdraw men from the pursuit of alchemy, but little was done in the way of pressing chemistry into the service of man before the appearance of Priestley, Cavendish, Lavoisier, Scheele, and a host of others who lived in the latter part of the last and the commencement of the present century. The two greatest discoveries made since men adopted the Baconian method of the interrogation of nature, were that matter is indestructible, and that force cannot be created. It is absurd

to compare the modern chemist with the dreamers of the Middle Ages. Scientific men no longer dream, they labour after the search of truth, and if the intelligent reader will only take the trouble to inquire into the rise and progress of the majority of our great industries he will soon trace many of the necessities of life and the luxuries of modern civilisation to the chemical laboratory—to the men who are permitted to spend their lives in obscurity—men who look for little or no reward for the blessings which they confer upon their fellow-creatures: these are the great high-priests of this age, to whom England owes much of her wealth and power.

Our visit to the works of Edward Cook & Co. at Bow, was a revelation. No fairy tale could exceed in wonder the marvellous transformations which daily take place within a stone's throw of Bow Church. The magician who presides over that vast establishment does not waste his time in searching for the philosopher's stone. The transmutation of valuable metals into the coveted gold would sink into insignificance compared with the changes which he works, not upon desirable compounds only, but upon the refuse organic matter from the food supply of the Great Metropolis. There is little in the name of Soap and Bone-manure Works to indicate romance. But a very interesting work dealing with the transmutations of the so-called waste products might well be entitled "The Romance of Science."

Some of the substances which enter Messrs. Cook & Co.'s works would soon be offensive and dangerous to health if thrown into dust-bins or cast away, but being quickly collected from the butchers' and from the dealers' shops they are converted into that most useful article soap, and some of it, too, of a quality so fine that the modern Beau Brummel, or "Masher" of the hour, would pine if he were deprived of such a luxury of the toilet. These transmutations of matter are almost unknown to the majority of persons who use the productions of such eminent firms as Edward Cook & Co.; therefore we shall, to the best of our ability, describe a few of the processes employed in the manufacture of soap, and the by-products obtained from animal fats and other animal remains. The vans belonging to the East London Soap Works are sent daily to all parts of London to collect fresh fat and bones from the butchers, and cooked bones and kitchen-stuff from the dealers, who purchase the latter from servant-maids. Each van delivers its cargo to the reception-house, and the bags of fat and bones are raised by means of an ingeniously-constructed steam-crane, which delivers the load on to a weighing-machine. When the bags are weighed and entered, the contents are carefully examined by men whose duty it is to reject all tainted pieces of fat when they are sorting the "sweet fats" purchased from the butchers. These latter consist of the clean caul fat which is sold as beef and mutton suet in ordinary consumption, so far as the retail demand for it goes, and of the rougher description of fat which forms the contents of what is known as the tallow-bag in slaughter-houses, and of the trimmings which occur in a butcher's retail trade. The beef cauls and sweet beef suet are put through machines like turnip-pulpers, and are then melted at a low temperature. The melted fat is obtained as a clean and pure oil, which is run into large casks; when solid it is put by for the manufacture of oleomargarine, which is exported to Continental markets. The manufacture of oleomargarine is a very simple process, and consists of re-melting this fat and pressing it in cloths at a temperature at which the stearine begins to solidify. The operation is simply mechanical, and when the stearine is taken away there is left remaining a fat which contains olein and margarine, the other chief constituents of all animal fatty matter. The stearine is sold to candle-makers, and the oleomargarine is exported to Continental markets, whence we obtain butters in return. The greater portion of the oleomargarine is sent to Holland, where it is added in proper quantities to the churns, thus increasing the yield of butter, or, as it is more correctly called, butterine. We tasted a sample of the oleomargarine obtained from pure beef fat, and we have no hesitation in stating that it is almost tasteless, "as clear as crystal," and infinitely superior to a great quantity of the vile stuff sold in London as butter at a good price. We could not help noticing the scrupulous cleanliness which is observed in the department where the oleomargarine is prepared. The men wear white blouses, and the place bore a stronger resemblance to a dairy than to a room in soap works.

The next room is devoted to beef fat of various kinds, other than caul and kidney suets, which are fresh and sweet. These are "pulped" as in the former case, and after being rendered down at a higher temperature than those intended for oleomargarine, are packed into casks, and are exported to Holland, where they form an article of consumption in place of dripping, and do *not* return. In passing, we must mention one important fact,—Messrs. Cook & Co. do not export these productions as butter. The dripping is labelled "Extra Zuiver Runder Vet," which translated means "Extra Quality Beef Fat." The Dutch people buy and use it as beef fat, and it is a strange fact that a Dutchman has to be employed at the East London Works to test the fat during the "rendering," in order to produce the flavour suited to the Dutch taste. From all these

distinctive renderings there are greaves, which are sold according to quality for the various purposes to which greaves are applicable, such as the feeding of pheasants and dogs. The next room is devoted to fresh mutton caul and kidney suets, which are converted into the tallow from which the best soaps are manufactured; and the next room contains fats that are not fresh, and which are made into tallow for other descriptions of soap.

The manufacture of soap is carried on in a most extensive manner at the East London Works. Some of the vats used for soap-boiling are enormous in capacity, each holding nearly 100 tons of soap. The tallow is mixed in these vats with ley, which is a solution of caustic soda or potash, by the agency of which the chemical decomposition of the fat and its conversion to soap is effected. Soaps are divided into hard and soft, the former having soda and the latter potash for their bases. The former, however, is the most extensively manufactured, whilst the demand for the latter is limited. The hard soaps, such as Gold Medal Primrose and Gold Medal Mottled, are used mainly for household purposes, but we saw also a variety of soaps, made to the most exact chemical analysis, for use in the great textile factories of the North of England; some made specially for particular Firms, who rely upon Messrs. Cook's exactness in manufacture in order always to have the same quality, as the slightest variation in the soap might do an immense amount of damage to their fabrics. The soft soap is largely used at home and abroad for machinery.

At Messrs. Cook & Co.'s works manual labour is reduced to a minimum, and steam and hydraulic machinery perform, under simple guidance, some astonishing automatic feats. The boiling of the soap paste is effected by blowing steam into the bottom of the vats. When the mixture of tallow and ley has become completely converted into soap, it is drawn off from the pan without hand labour by means of air pressure. The liquid soap is forced through pipes and troughs into the moulds. These are made of four cast-iron plates secured by clamps. The soap takes two or three days to cool and solidify, and the sides of the mould being then removed, the large block of soap is cut horizontally into slabs weighing 60 lb. each, which again are divided into bars of three pounds each by a wire frame. The bars of the finer qualities are cut into cakes, which are stamped in a press having a heavy falling die lifted by a cam. From the spent soap-leys is obtained that valuable product known as glycerine. In the early days of soap-making enormous quantities of glycerine were run to waste in the spent leys of the soap-maker, but now many tons a week are manufactured, and sold for use in making dynamite, an article for which there is a large demand for mining and blasting purposes.

On the occasion of our visit we were shown a great number of samples of soap, and we examined with much interest the special soaps made at Bow to suit the requirements of silk, cloth, lace, and cotton manufacturers, calico-printers, and others. We saw various qualities of mottled soap, palm oil, olive oil, and silicated soaps, also a splendid assortment of transparent and fancy toilet soaps, including the latest novelties, large cakes and moderate-sized slabs of scented old brown Windsor, to be sold retail at one penny and a halfpenny per cake. We were presented with a sample of a specially-prepared shaving-soap, which produces an excellent lather, and minimises the misery of the morning's scrape.

The other division of Messrs. Cook & Co.'s works comprises the utilisation of bones, kitchen refuse, and various other animal waste products. This grew out of the original soap-manufacturing industry. First of all come butchers' bones. These are assorted, and all the bullocks' leg and shin bones are put on one side. These are cut into marrow-bones or "pipes," by means of a circular saw, with great rapidity, the marrow-bones being thrown on one side, and the joint-ends on the other. The plugs of marrow, taken from the bones perfectly sweet and fresh, are melted down, and sold to perfumers, chemists, and others for the manufacture of pomades. The bone-dust from the circular saw contains a considerable amount of marrow, and is in great request by poultry fanciers as a most excellent food, requiring no preparation whatever. If not sold in this way it is boiled to extract the fat, and the residue is bone-dust. The marrow-bones are boiled to extract all the fat which may still adhere to them, and after being carefully washed are exported to France for the various purposes of bone manufacture for which Paris is famous. The joint-ends are thrown with other butchers' bones, which include fresh bones of all kinds, rump, shoulder, rib, &c., and the whole is then crushed by powerful machinery. Next come kitchen bones, collected from private houses, hotels, and rag-and-bone merchants. These have all been cooked, but there is an amount of fat in them which is worth extracting. They are sorted, to free them from dirt and rubbish, and are put through the crusher. Then all the crushed bones, fresh and stale, are boiled, or rather simmered; just sufficient heat is applied to them to take out all the fat.

Lately Messrs. Cook & Co. have erected a building containing boilers, in which the fat is extracted from the bones by a strictly scientific process. Benzine is employed, which dissolves the fat, and the benzine is all recovered and used over and over again. By this process much of the unpleasant odour which accompanies

the old method of extracting the fat from bones is avoided. The bone fat is run off into casks for soap-making. The bones, after the boiling, are dried, and ground by steam-power into the "half-inch bones" of commerce. In the screening of these ground bones—which is effected by sieves made on the same principle as tubular corn screens—the "bone dust" of commerce falls through first: the half-inch bones are sold as such, or are treated with sulphuric acid, and sold as dissolved bones. All this is done on a large scale; the tank containing the sulphuric acid holds a hundred tons, and the acid is conveyed through leaden pipes to the bones in large bins; the saturated bones are removed to storehouses, which are of great extent, and after screening the "dissolved bones" are ready for delivery. Another division of this department is devoted to what may be termed kitchen refuse. These consist of mutton-chop bones, pieces of fat, gristle, meat; in fact, all that comes off the plates, except vegetables. All this is boiled to extract the fat, which is used in the soap-house, and the residue, consisting of bone and sinew, forms "greaves," which is sold in a dry, powdery form, principally to hop-growers, who value it as a manure.

There is another division to this department, which consists of horn products derived from several sources. Horns and hoofs are found mixed with butchers' bones and with town refuse, and these are picked out and thrown by themselves. Cargoes of foreign horns and hoofs are also purchased by this Firm. On the occasion of our visit we were shown hundreds of tons of the hoofs of South American herbivorous animals. The tops of the horns, when suitable, are cut off by a circular saw, and sold to button manufacturers. The rest of the horny matter,—including horns of all kinds which are not good enough for the various industries which take boiled or steamed horn for their basis, and bullocks' feet from both home and foreign sources,—is ground in a mill, and sold to market-gardeners and others as a highly nitrogenous manure, of acknowledged value for special purposes. Bone manure is the oldest kind of manure used in agriculture, and although many patent manures have been highly puffed from time to time, the scientific farmers prefer bones prepared in the manner described to many of the new manures which flood the markets. Professor Henry Tanner, F.C.S., the eminent authority on the principles of agriculture, says: "The early use of bones upon dairy produce had a surprising effect, and they were therefore used with great profit. It is easy to understand why such good results followed their use. The lands had been used for feeding cows for many generations. Any herbage consumed by these cows would be robbed of its phosphoric acid, because the animal required a supply of phosphate of lime for the formation of milk and for the growth of the young calf, and very little would be returned to the soil in the excrements. If we examine the composition of milk, we find that there is one pound of phosphate of lime in about twenty-five or thirty gallons of milk, and it may be fairly calculated that the annual demand upon the land for each cow is equal to eighty pounds of bone. There was, therefore, a deficiency of phosphate of lime consequent upon this long-continued removal from the soil; and, *when bone was supplied, lands which had become almost valueless suddenly became rich and luxuriant.*" The Professor goes on to say that the use of bones was also extended to tillage land, and with equally satisfactory results. Large demands are made upon the soil for phosphoric acid by its continued removal in corn crops, and by sheep and other live stock, and as these had caused a deficiency upon ploughed lands like that we have already noticed upon the dairy pastures, similar benefits were gained by the application of bones. The use of bone thus became a settled practice, and was found to be highly remunerative.

Messrs. Edward Cook & Co. have various workshops in addition to the buildings used for the carrying on of their soap and manure manufactures. We passed through a carpenter's shop where men were employed in cutting up timber for various purposes by means of circular steam-saws. In the yard were immense stacks of small pieces of timber, cut in Norway to the sizes required for the construction of the soap-boxes. The name and address of the firm, Edward Cook & Co., East London Soap Works, are burned in, the raised letters on the branding-plate being heated by a number of gas jets. We saw, too, the manufacture by machinery of the tubs for soft soap. In the engineering shops repairs are done when any portion of the machinery breaks down. Altogether Messrs. Cook keep about thirty engines constantly at work. We noticed a cooper's shed where tallow-casks are repaired, and a pattern-maker's shop. This Firm employs so many horses and vans that it is advisable to keep a farrier, whose time is fully occupied in making and fitting horse-shoes; and a wheelwright's shop, for the repair of the vans. The works cover a large number of acres of ground situated in two parishes, which are traversed by tram-lines for the conveyance of goods to, and coals, &c., from, the barges which come to their wharfs on the River Lea. The comfort of the employés is studied by Messrs. Cook & Co., who have erected dining-rooms for both the clerks and the artisans, so that it is unnecessary for the men to leave the works at meal-times.

The excellent laboratory, the "brain" of the establishment, is fitted up with every description of apparatus used in chemical analysis, and presided over by a chemist of repute, whose time is fully occupied in seeing that all operations are conducted on scientific principles. No making, either of soap or of manure, is allowed to leave the works until it has been passed by the chemists. In a room adjoining the laboratory we were shown rows of small bottles containing samples of manure. When a farmer or merchant purchases a quantity of manure a sample is taken from the stock and handed to the chemist, who seals up the bottle, and affixes a label bearing the date, percentage of constituents, and the name of the buyer. This sample is placed upon the shelf and carefully preserved so that in case of a complaint it might be produced as evidence. Happily, Messrs. Cook & Co. have never had occasion to break the seal of one of these evidences of their scrupulous care.

The business done by this Firm must be enormous. Soap is made for, and stamped with the names respectively of, many smaller firms at the East London Works. Messrs. Cook & Co.'s preparations are sent to all parts of the globe, and no person who has an opportunity of inspecting their works and examining their system of doing business can fail to understand why they have earned such a splendid reputation in the mercantile world.

Messrs. Isaac Chorlton & Co., Manchester.

AMONG the many industries of this country which have had their birth during the present reign, we must not omit to notice the one of which Messrs. Isaac Chorlton & Co., of Manchester, are the acknowledged head, namely, the manufacture of metallic spring mattresses and of bedsteads combined therewith. An important part has been taken by this industry in bringing about the progress of sanitary reform which recent years have seen both at home and abroad; and few inventions are better calculated to promote the personal comfort and well-being of mankind. It was through the mattress known to the trade and to the general public by the name of "Excelsior," that the Firm under notice first gained their reputation as spring mattress manufacturers.

Before proceeding to a short description of their Works and an account of the goods which are there turned out, we have to thank Messrs. Chorlton & Co. for the kindness shown us, and for their readiness to give all information relating to the internal working of the different departments. Every facility has been offered our representative for becoming conversant with the details of the business, a large proportion of which are peculiarly interesting. There are not many ways of spending a few hours which are more agreeable and instructive than being shown round the extensive Works of Messrs. Chorlton & Co., in Water Street, Salford (the exterior of which is shown on the next page), where the utmost regularity, cleanliness, and order everywhere prevail; and where the most modern mechanical appliances, specially designed to meet the requirements of the trade, may be seen in all directions. Everything, too, has its own name and its appointed place, as it should have in any properly-regulated establishment.

The head office and show-rooms of the Firm are at 19, Blackfriars Street, Manchester, where neatness and order of course prevail as much as at the factory. Other offices, and show-rooms also, are maintained in London and Paris. On perusing the illustrated catalogue of Messrs. Chorlton & Co., one cannot but be struck with the careful attention they pay both to design and to utility in the manufacture of their goods; but to fully appreciate the results of this careful attention it is necessary to enter one or other of the show-rooms, where all the varieties of bedsteads, mattresses, &c., they produce are on view.

Reverting for a moment to the Works, we must mention that in order to meet the growing demand for their specialties, the Firm have made large extensions in the various departments of their factory; the working capacity of the mattress department, for instance, has been so increased, that they are now in a position to turn out in a finished state six or seven hundred mattresses per week, either separately or in combination with bedsteads. The space occupied for the making of their invalid couches and other cabinet-work is located on floor No. 1, and is 80 ft. in length. There are seven other rooms in the establishment, which are as follows:—No. 2, "Excelsior" chain mattress-room; No. 3, packing-room; No. 4, bedsteads, ship's berth, and tubular frame-making-room; No. 5, room for wire-weaving and for erecting and adjusting the frames; No. 6, room used for

storing couch and cabinet timber and for seasoning purposes; No. 7, pattern and designing-room; and No. 8, polishing and drying-room. Several large store arches and cellars in separate buildings are occupied with iron and timber, together with finished work. The rapidly-increasing demand—proof of the high estimation in which the manufactures are held by the public—necessitates a heavy stock being kept in readiness, so that prompt delivery can always be relied upon.

By a strict observance of due proportion, the Firm secure strength and durability, not only to the "Excelsior" chain mattress, but also to their other chain and woven wire spring mattresses, whether in combination with composite frames, or with metallic frames made with tubular sides. The composite frames, we should mention, are constructed with iron or steel end angles, and with sides of wood; in the construction of the tubular ones wood is entirely discarded. All these frames are so made as to allow the spring surface of the mattress to retain a uniformity of elasticity under constant and long wear, thus greatly enhancing the value

MESSRS. CHORLTON AND CO.'S WORKS, WATER STREET, SALFORD.

of the goods as articles of domestic use. By adopting also a uniform measurement, many of the parts of the different frames are made interchangeable, and will fit into one another without the slightest trouble. The Firm are working on what is understood in the mechanical world as the "Whitworth" principle, which secures duplicate fits to important parts of their productions.

Messrs. Isaac Chorlton & Co. appear to be giving special attention to quality in the manufacture of all their mattress-frames which by preference are made with metallic tubes. This tubular system of construction, we feel bound to say, deserves to be strongly recommended, seeing that increased strength is given by it, coupled with lightness. The metallic bedstead with metallic mattress-frame combined, as patented by them, is quite a novelty: it is made in many forms and sizes, and for convenience in moving can be detached in all its parts. No timber whatever is employed in its construction, and the risk of uncleanliness which always accompanies the use of wood is thus avoided. Messrs. Chorlton & Co.'s patents make the combination of mattress and bedstead a most substantial, reliable, and lasting piece of furniture. This specialty forms an important and attractive as well as novel feature in their exhibit at the Manchester Jubilee Exhibition.

Among the innovations of greatest importance which the Firm have introduced in the manufacture of iron bedsteads is the dispensing with dovetails, for which they merit the highest praise. The system of dovetails in the construction of metallic bedsteads is extremely defective, since the uprightness and rigidity of the head and foot ends of a bedstead made on this principle can never be relied on. By their patented arrangements, however, these great desiderata are perfectly secured; and the purchasing public are now enabled to obtain, what previously was not to be had, a sound-jointed, rigid, and upright bedstead.

One of the most striking of the Firm's novelties, and one we must by no means pass by without mention, is their invalid appliance bed, specially adapted for hospitals, asylums, and the sick chamber generally, which, by means of its mechanical arrangement for raising the patient to any angle, gives absolute security from accident. In addition, however, to bedsteads and mattresses, they have on view at the Manchester Exhibition some valuable sanitary adjuncts, such as folding-stretchers, metallic camp folding-beds, invalid spring couches and bed-rests, and ship's berth mattresses. There is also exhibited a patent double-tier or treble-tier ship's berth, specially designed with a view to comfort, and yet so constructed that every part can easily be detached and again put together. The facility gained by the use of this invention will be found highly advantageous when fitting up ships for troops or other passengers, or when afterwards dismantling them for cargo. It is also applicable for dormitories where space is valuable. We might say much more concerning the numerous appliances of the Firm for promoting hygiene and domestic comfort did space permit.

The benefit of their many unique and practical designs has been deservedly secured to the Firm by Royal Letters Patent. It is impossible to inspect their iron bedstead show-room, with all its varieties of patent goods, and to consider that within the last two years they have taken out some twenty or more patents, without feeling convinced that Messrs. Chorlton & Co. are determined by constant energy and activity to keep fully abreast of the times. From the character of their goods, also, the inference may be drawn that they are not disposed to sacrifice the personal comfort of the user for the sake of gain to themselves. Their great aim appears to be to unite strength with simplicity and lasting value in their manufactures, and, while adding to the comfort of the public, to keep sanitary advantages steadily in view.

The enterprise shown by the Firm deserves a world-wide recognition, on account of the bold move they made in departing from the old lines in mattress-making. To them also belongs the credit of having been the first to admit the imperfections in the ordinary bedstead, and, what is more, of having succeeded in discovering a remedy for the same. They have had, and still have, to do battle with prejudice, both on the part of the commercial world and of the public at large; but, of one thing we feel confident, that the prejudice in favour of wood will have to succumb, and make way for the general adoption of the metallic combined mattress-frames, as manufactured under the Firm's patents. This same spirit of enterprise which Messrs. Chorlton & Co. have shown in striking out on new lines has enabled them to attain and to hold their position as the largest manufacturers in the trade.

Well may people wonder that the old dovetail and angle-iron, with their radical defects, should so long have kept the field; but really it would appear that until Messrs. Chorlton & Co. took the matter up manufacturers had not deemed it necessary to bestow upon the construction of the metallic bedstead the amount of thought acknowledged as essential in producing every other article made for domestic comfort or convenience. It must be apparent, however, to all that, if iron bedsteads and spring mattresses are worth making, they are worth making well; and to do this is, undoubtedly, the aim of Messrs. Isaac Chorlton & Co. The trade-mark of the Firm, which appears on all their goods, and is a guarantee of their manufacture, is so artistic and original, that we think it not out of place to insert it here. The motto on the trade-mark, "Integrity," "Reliability," fitly represents the spirit of commercial rectitude which pervades the whole establishment.

Messrs. Musgrave & Co., Limited, Belfast, London, and Paris.

THER towns may present more picturesque forms to the eye, but Belfast, the capital of the province of Ulster, stands out as one of the greatest and most flourishing seats of industry in the British Isles. In the graphic language of Lord Macaulay, the place of domes and spires is supplied by edifices, less pleasing to the taste, but not less indicative of prosperity—huge factories towering many storeys above the chimneys of the houses, and resounding with the roar of machinery. Not only as the chief seat of the linen trade, but Belfast has also become famous in several other branches of manufacture, and notably in those connected with shipbuilding, machinery, and ironwork. Although no native or other iron ores have down to the present been smelted in Ulster, its proximity to the enormous iron-producing districts of Scotland and its exceptional shipping facilities have placed Belfast in a most advantageous position for carrying on any business requiring a supply of crude or manufactured iron.

This fact has been recognised and taken advantage of in many ways, but in no case more energetically and successfully than by Messrs. Musgrave & Co., Limited, of the Ann Street Iron Works, and Cromac Foundry, whose handsome and extensive premises are most conveniently situated close to the quays, and include commodious offices, show-rooms, and forwarding departments, from which latter the Firm's specialties are consigned to all countries of the world.

The present business was established many years ago by Messrs. Musgrave Brothers, a Firm which have been well-known in connexion with the iron industries of Ulster for close upon half a century. During the last fifteen years the concern has been carried on as a Limited Liability Company, the present directors being Mr. John R. Musgrave, J.P., D.L., Mr. John A. Hanna, and Mr. T. Foulkes Shillington. With the formation of the Company was ushered in a new era in the career of the business. Increased enterprise and vigour were brought to bear upon every branch; new and improved methods and appliances were introduced; and the Works were extended by the building of the large Cromac Foundry. In addition to this a new branch house was opened—in London, at 97, New Bond Street, and subsequently an establishment in Paris, at 240, Rue de Rivoli; all of which steps were rendered necessary by the continued growth of the business, and by the increasing demands made upon it by English, Continental, and Colonial customers. New branches of manufacture were added, and so the business has continued to grow and develop until it is now the largest in its own particular line of manufacture in the United Kingdom, if not in the whole world; and it takes, moreover, the leading position for originality of design and excellence of construction in its productions.

At a time when the comfort and health of horses and other animals received scant consideration from their owners, Messrs. Musgrave began to make the safe and sanitary housing of animals a subject of special study. This resulted in their designing and patenting a number of appliances for the purpose, and their specialties soon received highly favourable recognition from those interested in the subject. One of the earliest

successes of the Firm was that they secured the patronage of the Royal Family, and it is worthy of note that the execution and fitting of the stables built in recent years for members of the Royal Family in this country have been carried out by Messrs. Musgrave & Co. For instance, they have entirely fitted up the magnificent stables at Sandringham for H.R.H. the Prince of Wales. Similarly the new stables of the Duke of Edinburgh and the Duke of Connaught have been fitted up by them.

Members of the nobility have not been slow to follow the example set by Royalty, and it may be worth while to enumerate a few of the more important contracts in this connexion which have been entrusted to the Firm. Fine specimens of their work can be seen at Eaton Hall, the seat of the Duke of Westminster; at Aske Hall, the seat of the Earl of Zetland, and at Ingestre Hall, the lately restored seat of the Earl of Shrewsbury. On the Continent too their work is rightly held to be unrivalled, and the very extensive stables of Baron Adolphe Rothschild, Baron Edmond Rothschild, Baron Hirsch de Gereuth, of the Duchess de Medinaceli, Madrid, of the King of Holland, and of many other foreign notabilities, have been fitted

VIEW OF A STABLE FITTED BY MESSRS. MUSGRAVE AND CO.

up by them. In each of the above cases, the special appropriateness of the designs and the utility and perfect workmanship of the fittings have been uniformly acknowledged. As typical of this class of work we give above an illustration of a stable recently fitted by Messrs. Musgrave & Co.

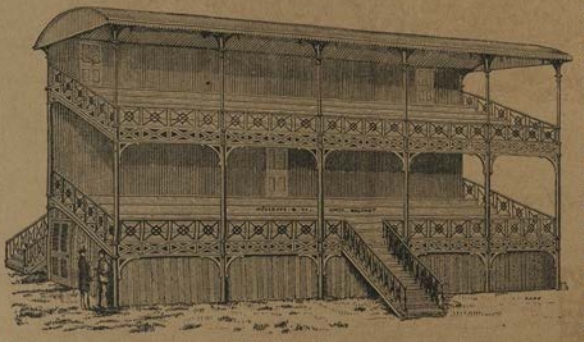
Quite as important in its way as the housing of horses is the comfort and health of cattle, and to this subject the Firm have given equal attention, as is attested by some of the finest farm steadings in the Kingdom. To particularise only two of these, the cattle houses on the estate of the late Sir Joseph Whitworth and more recently on that of Chevalier Whitehead of torpedo fame, have been fitted up by them. Both these gentlemen, be it remembered, were scientific engineers of the first standing, whose scrutiny nothing but the highest class work would satisfy.

Flattering testimony of a like character to the quality of the productions of the Ann Street Iron Works is borne by the fact that Messrs. Musgrave have from time to time carried out important contracts for the War Office, and many of the best barracks in this country have been fitted up by them, including the new barracks at Knightsbridge and Maryhill.

As affording evidence of the exceptional capabilities of the Works, it may be mentioned that in a

recent case of emergency there were produced, in addition to the ordinary regular work, complete fittings for cavalry at the rate of 250 stalls per week.

Intimately connected with the subject of fittings for horses is another specialty of the Firm, viz., the construction of Grand Stands for race-courses, &c., many of which have been erected on various courses, and one of these is illustrated herewith.



IRON RACE STAND.

Leaving now the subject of horses and their surroundings, and coming to matters more domestic, we find another special manufacture of world-wide celebrity, which like the foregoing owes its origin to Ulster genius — we refer to Musgrave's Patent Slow Combustion "Ulster" Stoves. For economy, durability, and convenience, these probably surpass anything of the kind ever introduced. It is not necessary to enter here into a description of the improvements effected in this stove to insure the economical consumption of fuel and the other advantages which have so markedly helped to popularise it and bring it into all but universal favour. From the time of its first invention repeated improvements have been made, until it is now in every respect perfect, insuring a maximum amount of heat, a minimum consumption of fuel, together with perfect combustion of the latter. As at present constructed the Musgrave Stove embodies the result of five distinct patents. Its great advantages were fully demonstrated at the Smoke Abatement Exhibition held at South Kensington a few years ago.

PATENT "ULSTER" STOVE.

The "Irish Stove" has become quite a household word on the Continent, where it is gradually replacing German and other stoves in competition with which it has been brought. Having been tested at an International Trial conducted in Paris by an officer of high repute, it was found to be unsurpassed for heating power and economical consumption of fuel. The accompanying illustration shows one of these stoves with an exterior of handsomely designed iron and porcelain work.

From the foregoing it will be seen how by building up their immense business Messrs. Musgrave & Co. have benefited not only the manufacturing population of Ireland, but have also added to the commercial prosperity of the United Kingdom by establishing for British workmanship, in their own branch, an unrivalled reputation; and by thus creating a foreign demand they have been the means of extending our commerce in Continental as well as Colonial markets.

Messrs. Glen & Ross, Glasgow.

MORE than a century has now passed since the prolific brain of James Watt conceived the idea of the direct-acting steam-hammer, although the actual development of this useful machine is of comparatively recent date. The idea was embodied by Watt in a patent, but there is no evidence to show that he ever carried it out in a practical form. The wants of the engineering world had not at that time given rise to the demand for anything more powerful than the hammer then in use—the "Tilt" or "Helve" hammer,—worked by steam, water, or hand power. It usually happens, however, that when any great discovery is made, which creates a demand for more powerful and efficient appliances than such as are in use, there arise men whose mechanical genius is equal to the occasion; and so it proved in this instance. When the introduction and rapid development of ocean steam navigation necessitated the production of forgings larger than could be manufactured under the helve hammer the means for making such forgings were soon supplied.

In the year 1840, Mr. Nasmyth, while on a visit to France, saw a direct-acting steam-hammer at work somewhat similar to what he had already conceived. He returned to England, took out a patent for the invention, and successfully introduced it to the engineers of the country. The design on which it was then constructed made it necessary to bring the framing down very near the anvil, thus leaving but little room for the workmen; the hammer-block and piston were raised by the steam and fell by gravity alone, which rendered the action slow; and finally the steam was admitted to the cylinder by a heavy slide-valve, requiring an elaborate and expensive self-acting gear to work it. Practical men noted these defects, and in 1854, William Rigby, of Parkhead Forge, Glasgow, took out a patent for a steam-hammer embodying several important improvements. Only one hammer was made by Mr. Rigby himself under his patent, when he transferred the whole of his rights to the Firm of Messrs. Glen & Ross, of the Greenhead Engine Works, Glasgow, who form the subject of the present article. These engineers designed and applied to the hammer an equilibrium piston-valve, which effected quite a revolution in the mode of operating it. Hitherto the cumbrous gear required to work the valve had given very sluggish results; but with the new valve, a simple hand-lever put any size of hammer under the most perfect control of the operator. The principle of this valve is to take the steam from the lower side of the piston, after it has raised the hammer, and to utilise it on the upper side for augmenting the force of the blow. The next step which the Firm took was to design an equilibrium valve, whereby full pressure of steam could be admitted on the upper side of the piston; by this means they succeeded in adding to the rapidity of action and increasing the force of the blow fourfold. This important improvement secured the general introduction of the steam-hammer to blacksmiths' shops, since it was found that a hammer of 5 cwt. or 6 cwt., with the new double-acting valve, could do the work of a 20 cwt. hammer on the old principle.

Messrs. Glen & Ross at the same time introduced the system of fixing the cylinder of the hammer to a single box column, instead of to the bridge-framing hitherto in use; this made the machine very compact and accessible to the workmen on three sides. The single box column and the double-acting balance valve were soon in high favour with all who used the steam-hammer; and at the present day, even the smallest smith's shop has one or more of these useful tools at work.

The Rigby steam-hammer of different designs has been adapted by the makers to a great variety of purposes. It is extensively used for the ordinary work of forging, shingling, wheel-bossing, and steel working, while in its lighter form it has been largely applied to stamping, general smith's work, boiler-flanging, wheel-veeing, and coppersmith's work.

Fig. 1 shows a hammer which is used for the lighter class of smith's work, and is made in sizes from 1 cwt. up to 5 cwt. The column, sole-plate, and anvil-block are cast in one piece, and the anvil-face is fitted into a recess cast in the anvil-block. When preferred, hammers of 2½ cwt. and upwards are made, with the anvil-block a separate casting, as in Fig. 2, which represents a hammer used for heavy smith's work or, according to size, for light forging or shingling. It is made from 6 cwt. up to 20 cwt. The column is bolted and keyed to a strong ribbed sole-plate, and the anvil-block—a solid casting with a broad base resting on a separate foundation—stands up through the sole-plate.

FIG. 1.

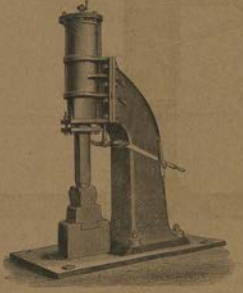


FIG. 2.

FIG. 3.

Fig. 3 is a type of hammer ranging from 3 cwt. up to 80 cwt. The hammer piston is forged in one piece, with a dovetailed end for receiving the hammer face,—an arrangement which affords great facility for changing the faces when required. Numerous hammers on this principle, from 20 cwt. to 80 cwt., are now used for forging purposes.

Hammers with double framing of arched cast-iron are made in sizes from 1 ton to 6 tons.

Fig. 4 shows the design of hammers of a heavier class, which have massive upright hollow standards of cast-iron and heavy wrought-iron rolled plate girders. This may be taken as the most recent and perfect development of the invention. The illustration we give shows a hammer of 13 tons,—that is to say, the hammer-piston and face are together of that weight. The internal diameter of the cylinder is 42 inches; and as the valve is arranged so as to give full pressure of steam on the upper side of the piston, the hammer strikes with tremendous force. The upright standards have a clear width of 20 feet, with a height of 13 feet 6 inches to the lower side of the cross girders.

In Figs. 5 and 6 we have illustrations of hammers made for special purposes, and largely used by marine engineers, boilermakers, and locomotive builders.

Messrs. Glen & Ross have supplied to the British Government and to many foreign Governments a large number of steam-hammers, both to work by hand and self-acting, and wherever the Rigby Hammer has been exhibited it has received the highest awards. In concluding this brief account of what has now

become an important industry, we feel bound to make reference to the attempts which have been made by unscrupulous parties to secure to themselves the advantages of the reputation which the Rigby Hammer has

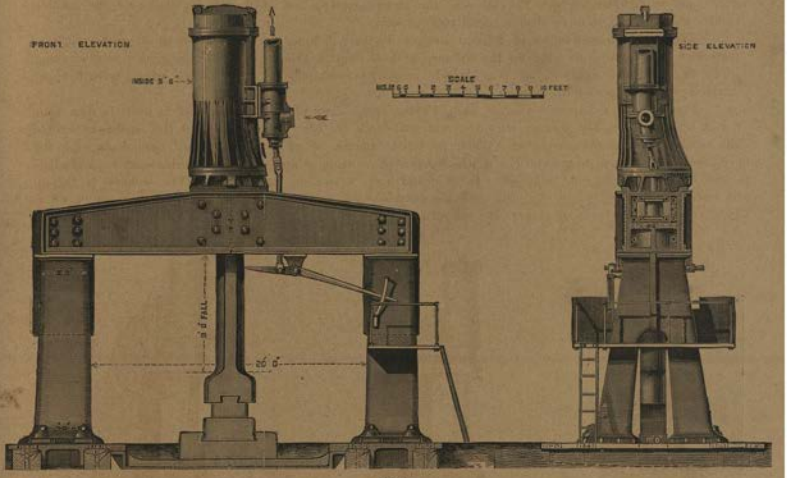


FIG. 4.

earned. When the Trade-Marks Registration Act came into force some ten or more years ago, the Firm under notice registered the words "Rigby's Patent" as their trade-mark, in order to prevent the benefit of

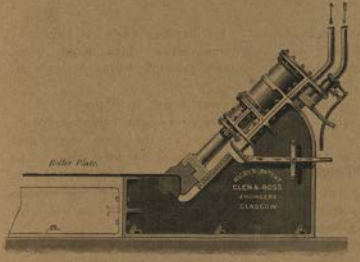


FIG. 5.—FOR FLANGING BOILER PLATES.

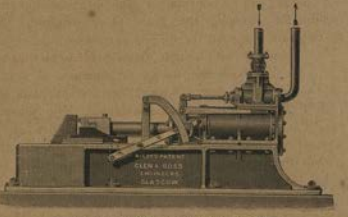


FIG. 6.—FOR VEEING LOCOMOTIVE WHEELS.

their labours in developing the steam-hammer from being snatched from them. So wide-spread had the fame of the Rigby Hammer become, and in such favour was it held, that when the patent expired other makers were not slow in attempting to reap the benefits of the labour and outlay of Messrs. Glen & Ross.

Hadfield's Steel Foundry Company, Sheffield.

NO branch of industry has more powerfully influenced the commerce of Great Britain during the reign of Queen Victoria than the manufacture of steel. Within the past few years great attention has been paid to the investigation of the chemistry of iron. The researches of Despretz and Fremy tend to the conclusion that nitrogen exercises an important influence over the phenomena of "Steeling," and that carbon plays a less necessary part, while those of Caron and Deville still refer the formation of steel to the chemical combinations of iron with carbon. Cast iron, wrought iron, and steel are all combinations of iron and carbon, differing in the amount they contain of the latter element. As cast iron contains a larger, and wrought iron a smaller, proportion of carbon than steel it follows that to convert the cast iron into steel excess of carbon must be removed, while conversely to make the wrought iron into steel the requisite amount of carbon must be added to it. Manganese also possesses the property of improving steel, and although some investigators point out that a very minute quantity of the manganese is taken up by the steel an indirect influence is exercised by it, viz., its power of carrying away any prejudicial excess of sulphur and phosphorus, and in this manner contributing to the increased purity of the metal.

Several patents have been taken out for the manufacture of steel, but no greater amount of success has been achieved than by Hadfield's Steel Foundry Company, of Sheffield, whose steel castings are to be found in every part of the civilised world. The uses of cast steel for mechanical purposes are almost co-extensive with the limits of industrial operations. Indeed, for almost all structural and engineering purposes where ordinary cast iron can be employed, that material may be profitably superseded by cast steel. Where strains are continuously severe or sudden and intermittent, cast steel is immeasurably superior to cast iron. In fact, its durability is practically unlimited, and if the cast steel trade has any reason to fear an untimely end it will be brought about by reason of its own productions never requiring renewal. Although steel castings are more costly than iron the increase in the first outlay is greatly counterbalanced by the extreme durability of the material obtained, and, further, by its comparative lightness of weight, the equal facility with which it can be manipulated, and its great strength and strain-resisting capabilities. This lightness is of special advantage for export purposes, effecting a considerable saving in freight, and also in transport amongst newly-opened countries and parts difficult of access. But as an industrial product cast steel has other uses than those of a structural and engineering character. The purposes to which it is applied include indeed the whole range of articles which come under the head of cutlery. Nearly all kinds of heavy and light tools, too, are made from one description or another of cast steel, and in every branch of industry its utilisation in some one of its forms is met with.

The Hecla Steel Foundry, Sheffield, is one of the principal and most extensive cast steel

producing establishments in this country. Admirably representative of its class and interesting on more accounts than one, it is designed for the greater part on purely modern principles. A bold and well-built frontage seems to give an outward indication of the order and substantial activity which prevail within the premises. There is another distinguishing characteristic of the Hecla Steel Foundry which is worthy of special note. Many manufacturers of steel make the production of steel castings a *part* of their business, but we are not aware that any other large Sheffield steel-works are laid out specially for the production of steel castings, as in the case of the Hecla Foundry, which is devoted *entirely and exclusively* to their manufacture. Everything here is particularly applicable to the manipulation of steel castings, from the smallest machine tool to the vast new workshops themselves, which are, by that inevitable process of evolution which seems to accompany the success of great industrial undertakings, superseding the smaller and less convenient premises that formed the original basis of the present establishment: including extensive moulding-shops fitted with steam cranes and illuminated by the electric light; powerful machine tools; annealing stoves, each capable of annealing from 15 to 20 tons of steel castings at one time; dressing-shops, where a large staff of workmen are constantly engaged in dressing large and small castings; smith-shops for testing the marvellous strength and powers of resistance possessed by steel castings; machine-shops for the tooling work, where may be seen immense stocks of castings of all kinds, in which colliery wheels are always strikingly prominent. In passing, we may inform our readers that at the Hecla Steel Foundry between 1,500 and 2,000 colliery wheels are produced weekly, while the demand for them continues to be of a steadily increasing character.

The new machine-shops—a noble series of workshops—are amongst the most excellently-appointed in the kingdom. To begin with, the shops are well planned, neatly and substantially built, and adequately supplied with over-head travellers and other lifting arrangements. These over-head cranes, built on the newest principles, are worked by ropes, and such is their simplicity that any ordinary unskilled labourer can, without assistance, lift and take from one part of the shop to another loads of ten tons with perfect ease and safety. The machine-tools comprise planing, drilling, and slotting machines, hydraulic and steam presses, steam hammers, steam cranes, lathes of all sizes. The cutting tools used in the machines are made of an extremely hard steel, manufactured by Messrs. Hadfield specially to stand the severe work of cutting steel castings, and which has to be very carefully tempered to maintain a cutting edge against the tough castings.

The extensive pattern stores at the Hecla Foundry contain as many as 15,000 different patterns, over 1,100 of which are for wheels alone, and the aggregation must certainly represent a vast amount of expended labour and capital. In the manufacture of cast steel much importance attaches to the proper proportions of the materials constituting each charge, and defects in the product can be readily traced to the original source. At Hecla Steel Foundry this is fully recognised, and a well-organised laboratory is doubtless one of the most important factors in the production of Messrs. Hadfield's well-known cast steel. The facilities provided by the laboratory for chemical tests and analyses enable the Firm to make a thoroughly uniform material with almost uniform certainty, and to avoid the mishaps by which the productions of makers whose establishments are less adequately equipped and who work on old lines are so liable to come to grief. Mechanical tests are also very freely adopted, and have hitherto comprised over two hundred different experiments by H.M. Government, Kirkaldy, Professor Huntington, Professor Kennedy, and others, to determine the tensile strain, elongation, compression, and the like. To give some idea of what has been accomplished with unhammered steel castings, we understand that results showing 40 tons to the square inch in tensile strain, and 20 per cent. in elongation, have been obtained. With the Firm's special mild-hammered steel a tensile strain of 31 tons to the square inch, with 30 per cent. elongation, has been obtained,—a somewhat startling advance upon the steel of even eight or ten years back.

A special hard quality of unhammered steel castings has given as much as 65 tons per square inch tensile strain, with 6 per cent. elongation—a result which nearly approaches to an equality with Whitworth's expensive compressed steel—a wonderful result, seeing that this material had not been subjected to any mechanical treatment whatever, but was simply in its cast state, annealed, and passed through the Firm's special processes. In the course of manufacture the steel castings as they leave the moulds do not appear so smooth as cast iron, but when it is borne in mind that the temperature of ordinary molten cast metal is about 2,000 degrees Fahrenheit against molten cast steel, 3,000 degrees, it will be readily seen what greatly increased difficulties steel founders have to contend with in this point. Naturally cooling down from this intense heat means greater contraction, consequently all patterns for steel castings have to be made ¼ inch per foot larger than the finished castings are required to be—that is double the amount allowed for cast iron. Messrs. Hadfield would construct for a cylinder 22 feet in length a mould 22 feet 6 inches, thus allowing six inches for

contraction when set, as compared with the molten state. It will, therefore, be seen what a serious obstacle this increased contraction is to deal with, and unless the material is very equally proportioned the castings are liable to pull themselves in pieces when cooling. Annealing extending over a considerable period gives the castings a toughness and density of nature, and the particles an unstrained connexion with each other which equips them to meet the various forces to which they will be opposed. Then as regards smaller articles comes the cleaning, simple and thorough—a mere rapid motion of a number of miscellaneous articles within a revolving drum, ensuring by their contact with each other a freeing from sand and clearing of rough places. The noise in this department is, perhaps, not pleasant, but it is extraordinary to notice the severe tests to which the castings are subjected in this revolving machine, being rolled about for more than an hour together. Similar articles in cast iron would be smashed to pieces, thus showing, even at this early stage, the great difference between the two materials. Steel castings of every description are to be seen in course of manufacture at Messrs. Hadfield's works, comprising those for railways, tramways, hydraulic and other engines, agricultural and general castings, machine-moulded gearing, &c., ranging from a few pounds in weight up to 6½ and 7 tons each: those castings forming parts of machinery that have to be turned and bored, then pass on for manufacture in the various lathe, planing, slotting, and drilling machines already referred to. But for general work, wheels, rollers, pulleys, and pedestals are now practically ready for being fitted up. There is scarcely anything in

TESTING A WHEEL.—The wheel shown on above anvil has been tested with 45 swinging blows of a 14 lb. sledge hammer, and only bent as shown.

machinery that cannot be made of this material, and Hadfield's large works show how extensive its application has become.

We have referred to the process of making steel containing manganese, and the chemical theory of the combination of iron and manganese. We will now briefly refer to Messrs. Hadfield's new patent manganese steel. Until this Firm turned their attention to the subject it was supposed by eminent chemists and metallurgists that anything exceeding one per cent. of manganese would render the metal under treatment worthless, and any further addition thereof in excess of this proportion has been considered impracticable. In fact, Dr. Siemens had stated publicly on many occasions that the use of manganese was simply a cloak to cover the impurities in steel-making; that it covered a multitude of sins, and this was the general opinion of the steel trade. Messrs. Hadfield, however, engaged in a long series of experiments and tests with the object of discovering its truth, and after a considerable expenditure of time and capital discovered that by adding the ordinary ferro-manganese of commerce to iron or metal, either wholly or to a great extent decarbonised and refined, and treated by any of the ordinary processes, or to steel, produced by such processes in increased proportions sufficient to obtain or produce in the steel or decarbonised iron under treatment, a percentage of manganese varying from 7 to 20 per cent., that the most

beneficial results could be obtained. Such percentage is regulated according to the purpose for which the steel is required. The ferro-manganese is poured into the molten steel under treatment, and thoroughly incorporated therewith. It is then run into ingot or other suitable moulds and allowed to cool, after which it is ready for use, as it requires neither tempering, rolling, forging, nor hardening. This treatment, varied slightly according to requirement, renders the steel so manufactured harder, stronger, denser, and tougher than most steel now manufactured, even when forged and rolled. For casting it has the advantage that it possesses greater freedom from honeycombs and similar defects; but the most peculiar property is its great toughness, combined with extreme hardness. Samples of this new steel exhibited at one of the annual general meetings of the Institution of Mechanical Engineers included a test bar, containing 12 per cent. manganese, bent double when cold, though hard enough for turning iron. A sample from the same ingot showed a tensile strength of 42 tons per square inch, with 20·85 elongation. Several hammered pieces, a manganese adze, containing 20 per cent. manganese, just as it left the mould, an axe, containing 12 per cent. manganese, just as cast in the rough, and had chopped through ½-inch square iron, were also shown. This last, like the others, had not been hardened or tempered, only the edge ground. There was also a large-size (about 1½-inch) wood chisel, which had been used in the pattern-shop fifteen months. A corve wheel, also, which had been tested with sixty heavy blows, showed a peculiar crystallisation. It contained 12 per cent. of manganese. None of this steel has the slightest magnetic capacity; it is a very poor conductor of electricity. It does not seem to oxidise easily, though tested by Messrs. Hadfield in sea water; it is said not to corrode as much as ordinary steel, nor to tarnish easily; and it is found that heating it to a white heat, and quenching it in cold water, instead of hardening it, causes it to become softer and tougher. In a discussion on this Patent Steel before the American Institute of Mining Engineers in May, 1884, Mr. Wellman, of the Otis Iron and Steel Co., stated that he had made a small quantity of steel under this patent with 12 per cent. of manganese and ·80 per cent. of carbon, and it gave a tensile strain of 49½ tons per square inch, with 21 per cent. elongation; and yet at the same time it was so hard that it required a day and a half to make the test piece.

Messrs. Hadfield's cast-steel wheels for colliery, tramway, and other uses form a leading specialty of the firm. It will be interesting to note that almost two millions of Hadfield's cast-steel wheels and axles are now in daily use in this country, the colonies, and foreign countries. Their special characteristics are toughness or density, lightness, durability, and solidity. Respecting their lightness, it is claimed by Messrs. Hadfield that their cast-steel wheels and axles are from 30 to 50 per cent. lighter than the same sized wheels in cast iron; consequently great economy is effected in haulage power, whether animal or steam. This point is of much importance in large collieries having an output of one thousand to two thousand tons, the reduced haulage power required in such cases amounting to a very considerable saving indeed. It is not easy to estimate the wearing life of these wheels, but after daily use for over twelve years they are found not to be worn out. In one case a set of 9-inch wheels and axles fitted by Hadfield's patent fast method, after running 41,000 miles, carrying nearly 10,000 tons, and being in constant work for five years, were found to be worn little more than one-eighth of an inch on the tread. In another instance a contractor's wheel, 30 inches in diameter, which ran 11,000 miles, and carried 33,000 tons of earth-work, was worn merely one-eighth of an inch on the tread. Again, on one occasion a set of wheels which fell from the top to the bottom of a colliery shaft 1,770 feet deep, escaped unbroken and merely bent. One firm has over 3,000 sets of Hadfield's wheels and axles in daily use; and although the greater number of these have been in use for years no breakage from any cause has ever occurred. In short these wheels must be allowed to be practically indestructible even under the roughest usage. The patent "Hecla" steel wheels, it should be stated, are cast in one piece, and the tyres may be worn down to the wheel centres without liability to any of those accidents to which the tyres of ordinary wheels are subject. When the steel tread is completely worn out, a new tyre can be shrunk on or fastened thereto by merely turning off the flange to the level of the tread, thus allowing a new wheel to be formed of the old one, practically doubling the life period of an ordinary tyre. Those who use the wheels state that they possess greater elasticity than ordinary railway wheels, and are better able to withstand sudden shocks or applications of brake power. The rise of Hadfield's cast-steel wheels is, however, by no means confined to railways. The Firm manufacture a special class fitted for tram-cars, and these latter possess all the advantages claimed for the railway wheels just described, and weigh only about half as much as the American wheels generally in use. These steel tramway-car wheels have already been largely adopted in London, Liverpool, Manchester, Bristol, Sheffield, Newcastle-on-Tyne, Dublin, Derby, Paris, Birmingham, and many other large towns at home and abroad.

Messrs. Hadfield also manufacture a variety of steel rollers and pulleys for mining and other engineering operations, more particularly where wire ropes and chains are employed, thus avoiding much of the cost of renewing plant in collieries, ironstone mines, lead and copper mines, quarries, &c., where considerable expense is periodically incurred by the repeated deterioration of wires, cables, ropes, &c., used in hauling and transmission of power from point to point. A patent self-oiling cast-steel wheel is also manufactured for use in collieries where loose wheels and axles are employed. Steel castings up to 16,000 lb. weight each, for replacing expensive wrought-iron and steel forgings and heavy iron castings are also produced in great quantities. Hydraulic and other cylinders form an important item in the list of productions of the Hecla Foundry. Out of the hundreds of steel cylinders Messrs. Hadfield have delivered, whether for export or for home use, they have never yet heard of a cylinder bursting. Out of a similar number of cylinders made, and during the same time, it may be estimated that more than 75 per cent. of them would have had to be replaced had they been made in iron, and three times as thick; indeed, cast-iron cylinders appear now to be seldom ordered, steel having practically taken their place. Hydraulic pumps made of steel are a great success in place of brass; they cost less, they are readily machined, and there is no risk of bursting. Steel press-plates and boxes cast in one piece have proved to be superior to cast and wrought iron, and being much thinner five boxes can be made to occupy the original space of four, thus enabling an extra cake being produced per quarter of an hour in each press, besides securing increased strength. Seed-crushing rolls promise favourably, and being made of a special tough homogeneous and close-grained quality outlast several iron ones, and seldom require turning up in the lathe, which cannot be said of iron rolls, as seed-crushers know to their cost.

It will be interesting to note the successes which Messrs. Hadfield have met with at the International and other Exhibitions at which they have from time to time competed. At the International Exhibition in London in 1862, the Firm was awarded Honourable Mention, and ten years later, at another display in London, they obtained a Prize Medal. This was followed by their obtaining highest prize medals at Leeds, Manchester, and Wrexham during 1875 and 1876, and a Gold Medal at Paris in 1878. At Sydney, in 1880, Messrs. Hadfield were awarded a Special Diploma of Honour, also a Silver Medal; and both at Melbourne in 1881, and at the International Metallurgical Exhibition held at Madrid last year, they obtained the only Gold Medals awarded for steel castings. Messrs. Hadfield also obtained the highest award for steel castings at the Calcutta Exhibition, namely, a First-Class Certificate and a Silver Medal. They also obtained the highest possible award at Cornwall two or three years ago.

Many noteworthy castings have emanated from the Hecla Steel Foundry during the past few years. One of their 9-inch cast-steel shells was fired against an 11-inch compound armour plate, which is equal to a thickness of 15 inches in wrought iron, and penetrated it 8¼ inches, while the penetrating power of ordinary Palliser shells in such a case is three inches. The velocity was 1,520 feet per second, and the energy developed 4,300 foot-tons, thus indicating what can be done with an unhammered steel casting of the Hadfield type. Since the above trials some further tests have been made at Shoeburyness, and one of Hadfield's patent 6-inch shells was fired against an 8½-inch Brown's wrought-iron plate, completely penetrating it without injury to the shot. The shot itself was found some distance on the other side of the plate, and was in such a perfect condition that it could have been fired again from the same gun. Seeing that this was simply a steel casting, neither hammered nor forged, the result was most extraordinary.

Messrs. Hadfield's castings are now used by the Admiralty, the War Department and Royal Laboratory, by the Governments of France, Belgium, the Cape, New South Wales, South Australia, New Zealand, Queensland, India, and Egypt, and by the leading home, foreign, and colonial railways, while private firms all over the world are extensive users of their manufactures. It has been said that the day when cast iron will yield almost entirely to its more formidable, durable, lighter and stronger rival is not far off, and we may now be fairly said to have entered into the Era of Steel, one of the most important epochs the world has seen since the dawn of the Age of Iron.

The Royal Tapestry Works, Windsor.

THE introduction of tapestry weaving into England is usually attributed to a gentleman named Sheldon, late in the reign of Henry VIII. Lady Wilton, however, in her interesting book on needlework, mentions an intimation by Walpole of its origin as early as the time of Edward III.; but, if any attempt was made to introduce the art at that time, it does not appear to have produced any important result. According to this author, Sheldon allowed an artist named Robert Hicks to use his manor-house at Burcheston, in Warwickshire, for the practice of the art, and mentioned him in his will, which was dated 1570, as "the only auter and beginner of tapistry and arras within the realme." At Burcheston were worked in tapestry on a large scale maps of Warwickshire, Oxfordshire, Worcestershire, and Gloucestershire, some fragments of which were, it is stated, in Walpole's collection at Strawberry Hill. Little more is known of this establishment. James I. endeavoured to revive the manufacture of tapestry by encouraging and assisting in the formation of an institution at Mortlake, about 1619, under the management of Sir Francis Crane. James I. gave £2,000 towards the foundation of the Works, which appear to have been originally supplied with designs from abroad, but subsequently by an artist named Francis Cleyne, or Klein, a native of Rostock, in the Duchy of Mecklenburg, who was engaged for the purpose. This undertaking was a special hobby both for James and his successor, who regarded Cleyne so favourably that he bestowed upon him, in 1625, an annuity of £100, which he enjoyed until the civil war. In the same year Charles I. granted £2,000 a year for ten years to Sir Francis Crane, in lieu of an annual payment of £1,000 which he had previously covenanted to pay for that term, "towards the furtherance, upholding, and maintenance of the worke of tapestries latelie brought into this our kingdome by the said Sir Francis Crane, and now by him and his workmen practised and put in use at Mortlake, in our countie of Surrey; and of a further sum of £6,000 due to the establishment for three suits of gold tapestries."

After the death of Sir Francis Crane, his brother Sir Richard sold the premises to the King, and during the civil war they were seized as royal property. After the Restoration, Charles II. endeavoured to revive the manufacture, and employed Verrio to make designs for it; but the attempt was unsuccessful. Lady Wilton, however, conceives that, although languishing, the work was not altogether extinct, "for," she observes, "in Mr. Evelyn's very scarce tract entitled 'Mundus Muliebris,' printed in 1690, some of this manufacture is amongst the articles to be furnished by a gallant to his mistress." During its period of prosperity were produced the most superb hangings, after the designs of celebrated painters, with which the palaces of Windsor Castle, Hampton Court, Whitehall, St. James's, Greenwich, &c., and many of the mansions of the nobility, were adorned. Five, at least, of the cartoons of Raffaele, which appear to have been bought by Charles I. for that purpose, were worked in tapestry at Mortlake. These celebrated works were designed for the purpose of being copied in tapestry, and were originally worked in Flanders. An Act of Parliament was passed in 1663 to encourage

the linen and tapestry manufactures of England, and to restrain the great importation of foreign linen and tapestry.

"The tapestries," observes the Countess of Wilton, "whether wrought or woven, did not remain on the walls as do the hangings of modern days; it was the primitive office of grooms of the chamber to hang up the tapestry, which, in a royal progress, was sent forward with the purveyor and grooms of the chamber." In a subsequent chapter on "The Days of Good Queen Bess," after showing the universality of tapestry and similar decorations in the houses of the nobility and gentry of England, it is stated that tapestry was at that time suspended upon frames, which were, probably, in many cases, at a considerable distance from the walls, as we frequently read of persons concealing themselves, like Falstaff ("Merry Wives of Windsor," Act iii. Scene 3), "behind the arras." Tapestry weaving appears to have been jealously watched by the masters of the trade in England, for we find the following curious judgment given as to tapestry made of false work in Riley's "Memorials of London and London Life." In an extract from an early archive of the City of London, A.D. 1374, we read that "On Monday, after the Feast of St. Valentine (14 February), in the 48th year of Edward III., Henry Clerke, John Dyke, William Tanner, and Thomas Lucy, tapicers and masters of the trade of tapicers in London, caused to be brought before them a coster of tapestry wrought upon the loom after the manner of arras, and made of false work by Katherine Duchewoman, in her house at Fynkeslane, being 4 yards in length and 7 quarters in breadth, seeing that she had made it of linen thread beneath but covered with wool above in deceit of the people, and against the Ordinance of the trade aforesaid; and they asked that the coster might be adjudged to be false, and for that reason burnt according to the forms of the Articles of their trade as here in the chamber enrolled, &c. And whereas the said Katherine was warned to be here on the morrow to shew if she had aught to say why the same coster should not be burnt, for the reason aforesaid, she did not afterwards appear, &c. Therefore, after due examination thereof by the masters aforesaid and other reputable men of the same trade, by assent of the mayor, recorder, and certain of the aldermen, it was ordered that the said coster as being false work should be burnt according to the form of the Articles of the trade of tapicers aforesaid."

The tapestry looms, which ceased their operations in the reign of Charles II., have, in these days, found successors worthy of the past, if beauty of design, harmony of colour, and delicacy of detail are taken into consideration.

To Mr. Henry, the artistic director for Messrs. Gillow & Co., is due the honour of having revived an art which had apparently passed away. In 1876, at Windsor, was obtained a fit manufactory, with appropriate cottages for the artificers, and a common hall, wherein cartoons and original pictures could be hung up for the contemplation and inspiration of those engaged in the production of tapestry. How Mr. Henry brought together the looms and workers for executing the finest work is a story full of interest. After four years of unflagging effort his triumph became complete. At last was established an institution satisfactory in every detail, a manufactory significant in the perfection of its machinery, and busy with a highly-trained staff of workers. The time now became ripe for the crowning of the edifice originally fostered and brought to maturity under the patronage of monarchs. His Royal Highness the late Duke of Albany with other members of the Royal Family had taken a deep interest in the progress of this laudable enterprise from its inception. Consequently, when the organisation became ripe for incorporation, the institution was constituted into a royal factory, with a committee of management, under the presidency of the Prince whose name is above mentioned. The founder of these Works first called about him a body of carefully-chosen French employés. The excellence of tapestry depends on the delicate sensibility and fine manipulation of the artificer. His hand must be cunning, and his eye be animated by a sense of colour nearly preternatural. His marvellous instinct in relation to colour may be conceived when it is stated that at the Royal Tapestry Works no less than 15,000 different shades are brought into use, many of which are so much alike that none but the most highly-trained eye can detect these finer differences. The Windsor Works make their own looms and dye their own silks. Twenty-five ouvriers, who are French, are employed in weaving; but these are supplemented by a body of English apprentices, who have shown themselves ready adepts in acquiring this difficult art. A time will necessarily come when the whole number employed will be Englishmen.

The beautiful productions of the Royal Windsor Tapestry Works exhibited at the International Exhibitions comprise the following:—A View of Windsor Castle, panels in tapestry depicting sylvan scenes in varying hues, showing a most exquisite combination of colour, with lights and shades rich in tone and variety; hangings showing respectively a deer and a boar hunt, which exhibit a masterly treatment equal to anything

produced in the palmiest days of tapestry. The screens prove how worthily tapestry can be utilised, not only for the luxurious decoration of our homes, but for our churches.

If the lovers of the beautiful desire to know more of the Royal Works, let them visit Windsor. There in the Common Hall, opposite the factory, they will see illustrations of the Seasons, after the French manner These illustrations show nearly every gradation of colour, from the richest twilight, with its multiplicity of tints to the saddest winter hues. Here, also, is a design for a colossal panel, one of a series of fifteen designed by the late Mr. E. M. Ward, R.A., for Mr. H. A. Brassey; also a tapestry of British Sports, manufactured for Mr. Vanderbilt, from the designs of Mr. Hodgson, R.A.

As an evidence of what can be accomplished, it may be stated that nearly every species of the painter's art can find reproduction in tapestry. *Souvenirs* from the collections of the Dukes of Argyll and Westminster were renovated at the Windsor Works, while the famous tapestries of Holyrood, at the command of Her Majesty the Queen, were repaired, and gave great satisfaction to Her Majesty. Distributed throughout English mansions are numberless specimens requiring such attention as can be only given at these Works, which not only employ a staff of artificers for the purpose of weaving, but many women who are devoted to repairing.

The Windsor looms have also produced a very fine set of panels illustrating the "Idylls of the Kings" for Mr. Coleridge Kennard, and at the present time are engaged on a series of historical hangings for the Corporation of London, besides some delicately-coloured panels in flat-tones and clear outlines, representing events in King Arthur's life, which are intended for Mr. Henry Hucks Gibbs's house at Elstree.

In conclusion, it may be stated that the Royal Windsor Tapestry Works have not been founded with a view to the acquisition of gain. They have been established for the national good, and on grounds essentially patriotic. The profits — and they are kept within the most reasonable limits — are expended on the enlargement and improvement of the establishment. Comfortable dwellings have consequently been provided for the workpeople, and a common hall has been raised for their especial benefit, so that under the influence of artistic associations the artistic taste and tone of the workers, who are liberally paid, may be cultivated and sustained. Such an institution as the Royal Windsor Tapestry Works is one worthy of national approbation. It has been strengthened and raised to its present high position under royal patronage by the valuable aid afforded by the late Duke of Albany. A great art enterprise such as this, claiming as it does public favour on public grounds, commends itself as well to all lovers of art as to all others who are mindful of the progress and improvement of the English people, and who feel that this country, in the race of artistic rivalry with others, should do its utmost by every effort, not only to make the people love art for itself, but to patronise it by every means within the power of wealth

The United Kingdom Tea Company, London.

MODERN existence is governed by two great factors—the social and the commercial. Everything that may benefit us socially is sure to be based on commercial lines. Inventors, Statesmen, and Scientists have conferred inestimable benefits on the human race, but none the less is credit due to the originators of commercial enterprise who bring within our reach every-day commodities pure, wholesome, and at reasonable cost.

The United Kingdom Tea Company are thus in the front rank of social benefactors.

The many profits which, in the ordinary way, are made on tea between the time it leaves the grower, and that of reaching the consumer, have not only tended to adulteration, but have so raised the prices, that pure teas of first quality are practically unobtainable. The United Kingdom Tea Company have directed all their energies to alter this state of things. By their mode of trading they bring within reach of the smallest consumer the pure teas of India, China, and Ceylon, at lowest market rates. The profits made by the so-called "middle-men" are saved, all teas supplied by the United Kingdom Tea Company being bought first hand from the importers, and sold by them again direct to the Consumer, thus avoiding intermediate profits.

The Company is composed of a syndicate of gentlemen who have had many years' experience in this especial trade. Numerous experts of the Company are employed examining, tasting, and valuing the samples of tea offered by the importers for sale, while their buyers daily attend the auctions at the Commercial Sale Rooms in Mincing Lane, where enormous quantities of tea are sold.

On the occasion of our visit to the Offices and Stores of the United Kingdom Tea Company, we had an opportunity of judging for ourselves the vast amount of business there transacted.

At the Offices, 21, Mincing Lane, which occupy the most prominent position in the Produce Market (being at the corner of Mincing Lane and the wide, busy thoroughfare of Great Tower Street, leading direct to the largest docks and bonded warehouses) we obtained an interview with the Secretary of the Company, who kindly invited us to walk through the Establishment. Numerous departments, filled with rows of desks, occupied by numbers of clerks, met our eye in every direction. The ledger department was particularly interesting; in these ledgers an account is opened with every customer of the Company, and by an ingenious system of indexing (an American patent) the clerks are enabled, when necessary, almost immediately to find the account of any customer. When we say that there are nearly 100,000 of these ledger accounts open with customers all over the kingdom, the extent of the work transacted in this department of the counting-house will be readily understood.

At the Duty-paid Stores, Leman Street, London Docks, which we were also permitted to visit, we found a large staff of men at work. Many were engaged in emptying the chests, as they were delivered from the Docks, into huge bins, each capable of holding nearly a ton weight of tea; others were attending to the

mixing machines, which turn out many thousand pounds' weight of tea per hour, and we were informed that the teas supplied are not in any way touched by hand from the time they leave the plantations until they reach the consumer. In the Packing Department, which was scrupulously clean, we saw the preparations for despatching the parcels of tea to customers on the Company's books. The reader will form some idea of the magnitude of the Forwarding Department when we state that the Post Office Authorities have specially to send large vans several times daily to the United Kingdom Tea Company's Stores to collect the packages of tea for transmission to all parts of the kingdom, these being in addition to the heavier packages forwarded through the various railway companies besides the large business transacted in London and Suburbs. In another department we saw the interesting process of coffee-roasting on an extensive scale; also the grinding of the fragrant berry. Consumers are actually supplied with tea by this Company at the same prices as those paid by grocers to the wholesale tea merchants. Teas with high-flown names are frequently offered to the public at prices out of all reason, as much as 5s. and 6s. a-pound being sometimes asked;—these fancy prices should never be paid; such quotations are unknown on the Mincing Lane market. It may be stated here, by way of explanation, that the United Kingdom Tea Company conduct their extensive business on the following principles: they have no agents or retail shops; they do not sell less than one pound of tea; their out-turn enables them to buy and sell every week first hand, direct from the importers, enormous quantities of tea, also of coffee. They supply tea at prices considerably lower than those quoted by any Civil Service or

THE UNITED KINGDOM TEA COMPANY'S OFFICES, 21, MINCING LANE, LONDON.

Co-operative Store; and they guarantee every leaf of tea which passes through their hands to be absolutely pure, and the best that money can buy at the respective prices. That such a public benefit should be highly appreciated by all classes of society will be easily understood. By every post the Secretary receives large bags of letters enclosing orders, amongst others, from the highest families in the land. The United Kingdom Tea Company supply several members of the Royal Family, the Refreshment Rooms of the House of Commons, the London and North-Western Railway Company, many of the asylums and hospitals in the metropolis, and a large number of the principal clubs and hotels in Great Britain. Their business is daily increasing, and we venture to predict that the "middle man" will soon be unknown, and adulteration in the tea trade an impossibility, owing to the meritorious efforts of the United Kingdom Tea Company.

That such an organisation has been most advantageous to the public is beyond doubt, and if proof be needed that this mode of trading is appreciated, it is amply afforded by the unprecedented support hitherto accorded and by the many thousands of orders daily received.

Commercial integrity and business capacity have ever commanded success; and whether these be directed towards scientific, national, or commercial enterprise, their aim is alike commendable. The United Kingdom Tea Company has become one of the landmarks of our national progress, and those who originated it well deserve the success which has attended their efforts; they have conferred on the British public a much-needed boon.

The history of Tea is so well known that only a cursory retrospect need be given. The following very plausible and well attested account of the manner in which tea was originally obtained from China is given in Macaulay's "History" of his embassy to China —

"Early in the seventeenth century some Dutch adventurers, seeking for such objects as might fetch a price in China, and hearing of the general use there of a beverage produced from a plant of the country, bethought themselves of trying how far a European plant of supposed great virtues might also be appreciated by the Chinese and thereby become a saleable commodity among them. They accordingly introduced to them the herb sage, the Dutch accepting in exchange the Chinese tea which they brought back with them to Europe."

There is distinct evidence extant that for some years prior to 1657 tea was occasionally sold in England at prices ranging from thirty to fifty shillings per lb. What a change has come to pass since that time! Tea is now sold by the United Kingdom Tea Company at as low a price as 1s. 3d. per pound, and no other evidence is needed to show us the enormous consumption which must have brought about this great alteration.

Not until 1668 is the East India Company credited with taking any steps for the direct importation of tea from China, which although it had been chartered since 1600 for the first time thought tea worth their attention as an article of trade. The order then sent to their agents was "For teas of the best kind to the amount of 25 pounds." But their instructions must have been considerably exceeded, for the quantity shipped was 4,713 pounds, a supply which seems to have glutted the market for several years! The first considerable shipment of tea, according to Walsh, reached London about the year 1690, from which period the tea trade increased rapidly until the closing years of the 17th century, when the importations averaged about 20,000 pounds per annum. In 1703, orders were sent from England to China for 85,000 pounds of green teas and 25,000 pounds of black. The average price of tea at this period was sixteen shillings per pound.

UNITED KINGDOM TEA COMPANY'S DUTY PAID STORES, IMPERIAL WAREHOUSE, LEMAN STREET, LONDON DOCKS.

Up to 1834 the East India Company enjoyed a monopoly of the trade with England in tea as in all Chinese products. Since then the trade has been open to all. As soon as the monopoly was broken up, shortly after the passing of the first Reform Bill, the Indian Government began to consider the feasibility of making Hindustan a great tea-growing country, and a committee was appointed to inquire into the matter. The indigenous tea plant had been discovered growing in Assam, about which it would seem there was at first some doubt, but in 1835 we find the Calcutta Tea Committee writing as follows:—"We are now enabled to state with certainty that not only is it (the *Thea Assamensis*) a genuine tea, but that no doubt can be entertained of its being *the identical tea* of *China*, which is the exclusive source of *all the varieties and shades of the tea of commerce*. The italicising is added and it matters little whether the teas of commerce are all obtained from the same species of tea plant or are not" [Staples]. The statistics of the tea trade show that the consumption of this delightful beverage increases every year.

China and India and Ceylon combined export to England some two hundred and fifty millions of pounds' weight of tea annually. Large and magnificent lines of screw steamers are now engaged in the service, freighted with these huge cargoes of tea, and by the shortened route through the Suez Canal are enabled to make the passage to London from China—a distance of at least 11,000 miles—in about six weeks.

The India Rubber, Gutta Percha, and Telegraph Works Company, Limited, London.

SINCE the introduction of the first practical electric telegraph in this country, just half a century ago, the progress made in the applications of electricity to telegraphy has far exceeded the wildest dreams of the earliest experimenters. It is a notable fact that the Jubilee of Her Majesty Queen Victoria and the Jubilee of the Electric Telegraph will be celebrated at the same time, and no subject is better suited to our columns than the development of a great industry which mainly owes its existence to the progress of electrical science and the requirements of inland and submarine telegraphy. In all parts of the civilised world the word "Silvertown" is accepted as a guarantee of good sound workmanship by all interested in the construction and maintenance of telegraph lines, and the success of the Company whose name heads this article may be traced to the scrupulous care with which every article manufactured is examined and tested before being sent out from the works. Space will not permit us to describe in detail all the manufactures of Silvertown; but a brief review of certain well-known productions of the above Company will no doubt be interesting to our readers.

The area of ground covered by these important works at Silvertown is about fifteen acres, the floor-area of the workshops being about ten acres; and the total number of engineers and workpeople engaged in telegraph work and the manufacture of India-rubber goods is rarely less than 2,800. In addition to this the Company has large works in France, where about 300 persons are employed in the same class of work; the total annual pay of the workpeople for both these establishments amounting to about £110,000 per annum.

The principal business of this Company, and probably the production of most interest to the public, is the constructing and laying of submarine cables, and this we propose to describe.

As is no doubt widely known, copper wire is generally used as the electric conductor in submarine cables. As the resistance opposed by the copper wire to the current of electricity is least with the purest copper, it is desirable that the wire should be as pure as possible, and the Silvertown Company use copper in all their cables that gives not less than 96 per cent. of the conductivity of pure copper, and, as a matter of practice, generally obtains from 98 to 99 per cent. conductivity. The wire is brought into the works in the usual coils, and, after having been tested electrically, is wound on bobbins by a machine with vertical swifts; when a stranded conductor is required, the bobbins, usually seven in number, are placed in a stranding machine, and there twisted into a wire rope known as a strand conductor. The conductor being made, it is necessary to insulate it; that is, to cover it with such a body as will prevent any leakage of the electricity from the conductor, and so insure the current passing through the whole length of the cable to the proper destination. The insulating material generally used is gutta-percha, and this is laid on in several coats, according to specification, in the manner hereafter described.

The bobbins of wire are placed on a frame at the back of a core-making machine, of a type which has been patented by Mr. Matthew Gray, the managing director of this Company, and the wire is first drawn through a tank containing Chatterton's composition, made of Stockholm tar and gutta-percha, which makes the gutta-percha afterwards applied take evenly on the wire and adhere to it. From this it passes through a cylinder, at the outer end of which is a die, and it is here that the wire is coated with gutta-percha. As it is necessary to get the insulating material free from air bubbles, which would be likely to leave holes in the insulating skin of the covered wire, the prepared gutta-percha is fed into a steam-jacketed cylinder by means of a pair of revolving rollers, which squeeze out the air. Inside this cylinder is a revolving worm, which continually presses the gutta-percha forward until it enters the die-cylinder referred to above. The gutta-percha, being under pressure and in a still plastic state, adheres to the wire conductor as it is being drawn through the die, the thickness of the insulating material depending on the diameter of the die. As soon as the covered wire, technically known as the core, leaves the die, it is necessary to harden the insulator, which up to that time has been kept warm and plastic by steam-jacketing all cylinders and tanks through which it has passed. To do this, the core, as it comes from the machine, is passed through a long trough filled with cold water, the water being kept at a low temperature by refrigerating machines worked by horizontal engines.

The core is now complete, and is tested electrically in the tank-room, where, coiled in two-mile lengths on large bobbins, it is placed in a tank containing water kept at a uniform temperature of 75° Fahr. Any defects in the insulation are here speedily detected, as the slightest defect would be discovered under the extreme conditions of tests now made, which are carried out by most delicate instruments, the beautiful reflecting galvanometers of Sir William Thomson being used. Should a defect be found, its position in the coil of core is localised in the following manner:—

The conductor or copper strand in the core of the cable offers a certain resistance to the passage of the current, and this resistance increases in proportion to its length, so that when one hundred miles of cable are in good order the conductor will offer a resistance equal to one hundred miles; but when a break occurs the resistance decreases in proportion to the distance of the break from the testing instruments, as the current finds an easier return passage through the water, and the point at which the break has occurred is thereby determined.

Having been thoroughly tested, the core is taken to the cable-making department, there to receive the protective covering. In this department there is a considerable quantity of machinery, some of it of very large size; here the core is again placed in tanks and tested electrically; in fact, throughout its whole manufacture the cable is perpetually under test, the testing arrangements being of the most complete character.

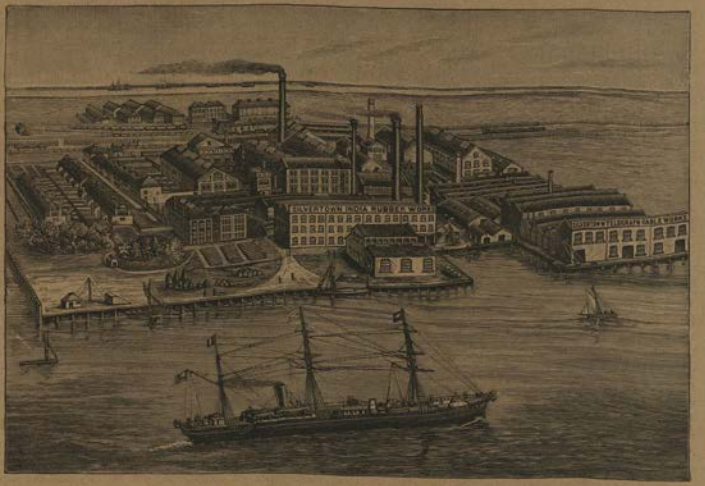
Having been tested, the core is led to the machine by means of pulleys through a disc carrying bobbins wound with jute; in passing through the lay-plate in front of the disc it is served with a layer of jute in one direction, and another layer is next put on in the same manner in the opposite direction. This jute serves as a bed for the protecting iron wires, which are next put on by means of a machine somewhat like a wire-rope-making machine of the eccentric type, the proper tension being kept on the cable during this process by carefully-adjusted hauling-off gear. The cable, in passing through the machine, next receives a covering of cold, sticky composition; this composition acts as a preservative, and causes the tapes or hemp cords, which are next applied, to adhere firmly to the wire sheathing, these tapes or cords being put on in much the same way as the jute serving.

The cable is now complete, and on leaving the machines is coiled in large tanks, whence it is transferred to similar tanks on board ship as required. The manner of armouring and serving depends wholly on the nature of the ocean bed on which the rope is to be laid, the study of this subject being one of the greatest importance and on it depends a good deal of the success a cable may attain, or at any rate the duration of its life. A submarine cable is by no means of uniform strength, the thickness depending to a great extent on the depth of the water. For instance, a shore end, being laid in the shallowest water and subject to great danger from the anchoring of vessels, will be the heaviest portion, sometimes weighing as much as 27 tons to the knot; the deep-sea portion may weigh as little as 1¼ ton per knot.

Some idea of the extent of submarine work carried out by this Company may be formed from the fact that they employ four specially-fitted steamers of a collective carrying capacity of 12,000 tons; one of these ships, the *Silvertown*, being the largest telegraph ship afloat. The cables of this Company are to be found in all parts of the globe where telegraph communication exists. Of these cables may be cited the one connecting

Galveston, U.S., with Valparaiso in Chili—a length of 6,300 miles; and cables connecting Cadiz with the Canary Islands and Senegal, and extending down the West Coast of Africa to St. Paul de Loanda, a length of 5,400 miles; the three cables from Marseilles to Algiers, and others we cannot here detail.

In addition to submarine cable work in Silvertown there are instrument shops, where the various kinds of telegraph instruments and apparatus are manufactured for Her Majesty's and foreign Governments, including the beautiful testing instruments before referred to; engineers' and carpenters' shops of considerable size for general work connected with the factory and submarine-cable making,—nearly all the machinery used in the works and on board the ships having been designed and constructed in the engineers' shop; battery shops, from which millions of the celebrated Leclanché cells have been turned out, the Company holding the patents for the manufacture of these cells. A great part of the works is devoted to the manufacture of all India-rubber,



THE COMPANY'S WORKS, SILVERTOWN, LONDON.

ebonite, and gutta-percha goods. Hundreds of tons of raw material are annually received at the Works from Central America, Africa, and the East Indies; the raw India-rubber is worked up by means of some very fine but powerful machinery into such articles as railway buffers, valves, bicycle and wheel tyres, tubing, hose, bands, washers, and rubber-spread cloth for the making of all classes of waterproof goods; and ebonite is largely used in the manufacture of acid pumps, battery cells, telegraph insulators, and soda-water corks.

The works are lighted throughout by the electric light, the installation being the finest private one in England, consisting as it does of more than 150 arc lamps, of from 2,000 to 3,000 candle-power each, and about 1,350 incandescent lamps, this installation having been carried out by the Company's electric light department, all the dynamos, lamps, and other electrical apparatus being of their own patterns and manufactured by themselves. The success of this installation is due, in a great measure, to their experience in the manufacture of electric light cables and conductors, a most important element in such work, where the conductors are required, as is often the

case, to be placed underground. The practical use of this large installation, for some years under their immediate supervision, has enabled them to acquire a thorough knowledge of all the details connected with Electric Lighting; and they are now prepared to make the necessary machinery, and fit up any Electric Light installations that the public may require. The Company, in addition, are large manufacturers of apparatus for torpedo and submarine work, possessing a complete system for harbour defence. On this, however, we do not propose to dwell, as it is only of interest to the technical engineer.

For driving the machinery used in these works forty-seven steam-engines and thirty-one boilers are employed.

The Company's head offices are at 116, Cannon Street, London, E.C., and they have agencies in the chief towns of the United Kingdom and abroad.

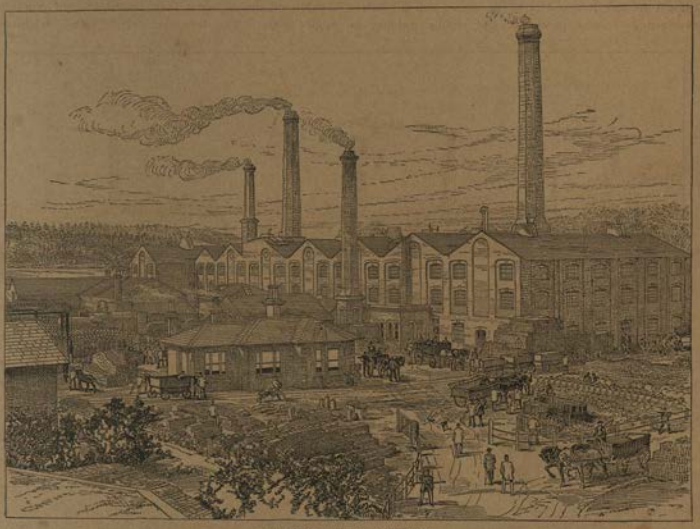
The South-Western Pottery and Terra-Cotta Works, Parkstone, Dorset.

ENCIRCLED by purple heather and pine-clad hills, the South-Western Pottery and Terra-Cotta Works form a conspicuous and familiar landmark, on the eastern shore of Poole Harbour, to travellers by the branch line joining the old-fashioned seaport with Bournemouth—one of the youngest, but most flourishing, of the watering-places on our Southern coast. A brief description of these Works as representative of an industry not only pre-eminent in local importance, but the products of which have earned a national and well-deserved repute, we here give. They were established, more than thirty years since, by the late Mr. George Jennings, of sanitary engineering fame, the founder of the well-known Firm to whose extensive business at Lambeth earlier reference in our pages has been made. By the clauses of the Metropolitan Building Act, London, 1845, which came into operation in that year, was therein set forth, that before the walls of any building shall have been raised 10 ft., an adequate system of sewerage should be constructed. Consequent upon this excellent provision, increased attention was directed to the subject of house-drainage; and considerable impetus given to the manufacture of glazed stoneware drain-pipes, which had already very generally superseded the brick and stone culverts heretofore employed.

Prior to 1854, drain-pipes were all made with sockets, into which the plain or spigot ends were cemented. In cases of stoppage they were as a sealed book, examination being impossible without destruction. Junctions could not be introduced without dislocating and destroying the continuity of the drain, and perfect restoration was equally difficult. In 1854 George Jennings produced his first improvements in drain-pipes, which enabled those having the care of the works to see if each pipe were truly laid and jointed, and permitted subsequent examination, or the introduction of a junction, without trouble or disturbance of the general drain. Finding, however, the advantages, claimed for his invention ignored or coldly received by London potters, to whom they were first submitted, he determined upon establishing a manufactory of his own, at first on a small scale, to test the value of his improvement, and afterwards to provide for its practical introduction to the public. For this purpose he obtained the lease of extensive clay lands at Parkstone, Dorsetshire, to which his attention had been directed; he was also fortunate in securing the co-operation of Mr. J. S. Hudson (the late manager), who had already been for some years practically connected with the trade. To Mr. Hudson's intelligent foresight is largely due the advantageous selection of the site and the arrangement of the Works, greatly facilitating their subsequent extension, which was speedily necessitated by the increased demand for the improved pipes, fulfilling the inventor's most sanguine expectations.

Unlike many of the principal potteries in the kingdom, and notably those near the metropolis, the material used in the production of Mr. Jennings' manufactures is obtained on the spot, the pits ranging to the north of the works which now cover an area of over twenty acres in extent. Mr. Jennings' inventive

faculties being directed into new channels, he produced successively numerous improvements and novelties appertaining to the building trade, many of which met with a similarly large measure of success; terra-cotta facing blocks, which were successfully employed in the construction of experimental huts at Hounslow for the Government, probably being the first instance of the use of such facings in connexion with concrete structures. Prominent, amongst other specialties, are the terra-cotta air-chamber smoke-flues; also the patent bonding bricks, sleeper blocks, and damp-proof courses, of vitrified glazed stoneware, and impervious to moisture. A house to be healthy must be dry at all times, warm in winter, cool in summer, and unaffected by external change of temperature. It must also be well-ventilated; and ventilation to be certain and perfect must be natural, requiring no thought or attention, day, night, or season; and these results so



TERRA-COTTA WORKS, PARKSTONE.

essential to the health and comfort of our homes may be obtained by the adoption of these inventions, the success of which is now an established fact. Besides the patent pipes, the manufacture of the ordinary socket pattern is also carried out on an immense scale, the sizes varying from 2 in. to 24 in. diameter. The undertakings entered into by the Firm for the supply of drain-pipes, sewer invert blocks and linings, and drainage connexions, include contracts with the Royal Engineer and War Departments and the Admiralty, involving shipments to British possessions in all parts of the world; also with the municipal authorities of Vienna, Frankfort-on-Maine, Warsaw, and many other Continental towns; as well as with the Government of South Australia, in connexion with the drainage of Adelaide, where a series of independent official tests proved the superiority of these pipes to those of any other maker, English or Colonial. These results are mainly due to the magnificent beds of clay available for selection on the Works, as well as to the introduction of improved steam machinery, by the aid of which the entire pipe is formed at one operation, including the

socket, which thus becomes an actual part of the pipe itself, and of equal strength, instead of being moulded on afterwards by hand, which is the method formerly and elsewhere ordinarily adopted.

To facilitate such large shipments of goods as above referred to, as well as the landing of coal, a pier and tram-line, nearly half a mile in length, has been constructed across the foreshore and mud-banks of Poole Harbour, at the head of which vessels of considerable draught can lay-to in deep water under the steam-cranes for the purpose of discharging and receiving cargo.

In the production of architectural and decorative terra-cotta of every description, the Firm also claim to have achieved a success which has gone far to remove the prejudice against this material, originating from the badly-burned misshapen blocks, so-called terra-cotta, having little in common with it but the name. Vast improvement, however, both in design and treatment, has lately been noticeable, and really good terra-cotta, as known to the Romans—true in shape, rich in colour, capable of the highest artistic treatment, and practically everlasting—is now produced, and rapidly gaining in public favour. The decorative dressings and enrichments

TERRA-COTTA WORKS, PARKSTONE.

of the late Mr. Jennings' residence near Clapham Common, although built nearly twenty years ago, is probably one of the finest specimens of terra-cotta work to be found in the neighbourhood of London. In order to meet the ever-increasing demand, the erection of additional buildings have recently been found necessary, and of these the modelling-rooms are amongst the most interesting in the Works.

Another department of scarcely less importance is that devoted to brick-making, conducted on what is known as the Hoffman system—a large circular building, containing machines capable of producing daily 20,000 cream facing-bricks of the finest quality, for which there is a considerable local demand, the output during the past three years exceeding 10,000,000.

In the necessarily limited space at our disposal, it has been impossible to attempt to give our readers anything more than a fragmentary outline of the principal features of interest which came under observation; but we were glad to receive a most encouraging account of the present condition of trade and its prospects, and, judging from the appearance of the various departments and their surroundings, we venture to predict the continued success of the Works and a large share of well-deserved prosperity.

The Tinplate Decorating Company, Melyn Works, Neath, Glamorganshire.

THE art of printing upon tinplates is an industry of comparatively modern date, and was introduced into this country from France in 1867, the English patents having been purchased by the Tinplate Decorating Company, of Neath, who gave the name of "Decorated Tinplates" to an article previously unknown to trade.

The invention and necessity for invention occurred at Nantes, where sardines, vegetables, and preserved provisions are largely packed in tin boxes which were formerly branded by means of brass labels attached by solder; but as these labels frequently became detached, the buyers were unable to identify the contents of the canisters, and in these circumstances the alternative plan was adopted of printing the required information direct upon the tin sheets, which were subsequently cut up and converted into canisters. It was soon ascertained, however, both in England and France, that Decorated Tinplates were available for many other useful purposes than provision canisters, and the development of the manufacture advanced by rapid strides.

The very elaborate and artistic designs which are now produced upon tinplate supersede the use of papered canisters, and render the material available for every purpose for which paper-labelled tin canisters were formerly used, and a large new use has been created for fancy boxes of all descriptions. One particular advantage of the decorated package is that the labels are not liable to discolouration by dust or damp, and the empty canister remains as a perpetual advertisement of its former contents.

As an addition to the original invention of printing in one or two colours, the Tinplate Decorating Company have recently purchased and added to their establishment the patent rights and entire plant which were formerly employed by their competitors, the London Tinplate Printing Company, of London, and they have thus acquired the means of producing by chromo-lithography the most highly-finished colour printing which has hitherto been accomplished upon metal.

In addition to their printing establishment, the Company have constructed an extensive factory for the conversion of the material into an almost endless variety of useful articles, for which purpose the most ingenious labour-saving machines have been imported from America, France, and elsewhere, giving employment to some hundreds of young persons. Amongst the more recent productions of the Tinplate Decorating Company we observed their "Jubilee" canisters and "Jubilee" waiters, ornamented with a most excellent portrait of Her Majesty in colours.

Space prevents us from enumerating the great variety of purposes for which Decorated Tinplates are now employed; but, perhaps, the most important use has been found for tea and coffee canisters, biscuit boxes, waiters, advertising tablets, and packages to contain mustard, blacking, and similar commodities. The productions of the Company, which are largely taken for export to all parts of the world, have been most successful in obtaining awards of the highest character when exhibited at Continental and Colonial Exhibitions.

Messrs. Leach, Flower, & Co., Melyn Tinplate Works, Neath, Glamorganshire.

THE manufacture of Tinplates is of German origin, and came to England from Bohemia in 1720. It was one of the many schemes which were introduced at the time of the South Sea Bubble, and it was one of the very few industries which were successfully established as a result of the mania for money-making which existed at that period. The manufacture was at first taken up as a dependency of the old charcoal forges, and was naturally limited by the necessity of obtaining water-power for driving the hammers and rolls which are employed in the trade. These water-wheels were later on assisted by steam-power, and dating from about 1860, large Works were established which were driven entirely by steam.

We consider the Melyn Tinplate Works, which were constructed in 1863, to be one of the best examples of modern arrangements, having regard to the completeness of the plant and to the economical arrangement of the necessary buildings. The Melyn Tin Works have from the first made a spécialité of high quality; their "K.C.B." brand has for many years led the trade for stamping purposes in the United States, and the "Melyn" tinplates are in large demand for the highest grade of tinsmith's work upon the American, European, and Colonial markets. The "Afan" brand is largely exported for meat-packing purposes in Australia and elsewhere, and the "Cymro" brand is in request for jams and biscuits, and similar purposes.

Following the introduction of steel, which has so completely revolutionised the iron trade, Messrs. Leach, Flower, & Co. have constructed a Siemens open hearth steel plant of the most complete character, but still maintain their charcoal forge, thus enabling the Firm to furnish either best charcoal or soft steel at discretion, and both of reliable home-made manufacture.

The Works, which cover about ten acres of freehold land, employ upwards of 600 workpeople, and produce in excess of 6,500 tons of tinplates yearly. The manufacture of tinplates for the wants of the whole world has now become almost a monopoly of South Wales, for the manufacture in Staffordshire is of an extremely limited character, and the production in Germany and France is barely sufficient for local requirements. The large quantity of tin which is taken for the coating of tinplates is the main support of the Cornish tin miners, and the consumption for this purpose of blooms and bars is of great assistance to the Welsh ironmasters when selling to the smaller Works who are not possessed of steel plant or forges.

Perhaps the largest English use for tinplates is for biscuits, and mustard, and similar articles which require air-tight packages to make them merchantable, and also to carry them safely beyond the seas. Tinplate canisters have also now become a necessity for the conveyance of food to English ports from foreign parts, whence salmon, beef, mutton, and fruits of all sorts are largely exported, not to speak of petroleum, for which purpose the consumption is enormous.

It seems to be most probable that, as the world continues to increase in population and wealth, this specialité of South Wales will become even more largely in demand than at present, and we do not know of

THE MELYN TINPLATE WORKS.

any position better calculated than the Melyn Works to provide for such requirements under the experienced management of the proprietors, who have given their personal attention to the manufacture since the Works were first constructed in 1863.

Messrs. Griffiths & Browett, Birmingham, London, and Paris.

REMARKABLE changes have been witnessed during the last half century in the processes connected with the manufacture of Tinplate Ware. Fifty years ago, such goods were, for the most part, supplied by small makers in all parts of the kingdom; and even at the largest establishments only hand-made articles were produced. The processes of manufacture were of a primitive description, and even small articles were formed out of several pieces of tinplate soldered together. The shapes were naturally of an uncouth character, the joints conspicuous, and the workmanship and finish clumsy, in addition to which the articles were expensive. Thus things had continued much in the old groove until Mr. T. F. Griffiths brought his inventive genius to bear upon the industry. His quick intelligence, his openness to ideas, and his practical good sense soon showed him the defects of the then system of working, and he set himself the task of inventing machinery which should do work better and quicker, and give a finer finish than had been obtainable by hand labour. The many improvements introduced by him have revolutionised the trade, and lifted it from the position of an inferior and minor handicraft to that of a branch of manufacture of considerable national importance. Only those who are able to recall the wretched work in tinware which was in general use at the time of Her Majesty's accession, can realise the immense boon which Mr. Griffiths's inventions and improvements have conferred upon competing manufacturers as well as the general public. He was thus, in every sense, a benefactor to his race, and his name ranks high among that illustrious band of men who have made Birmingham as a manufacturing centre the envy of the world. On the next page we give a portrait of this founder of the Tinplate Ware Trade as it now exists.

It was about a year before the date of Her Majesty's accession that Mr. Griffiths took out his first patent for stamping and burnishing, and he thus laid the foundation of a business which for its size, for the extent of its resources, the multiplicity of the processes carried on, the variety and excellence of its productions and the perfection of its workmanship, stands doubtless unrivalled throughout the world.

The business itself was established in 1820, and removed to a portion of the present premises in Bradford Street, Birmingham, in the year 1838, which have been added to from time to time to meet the growing requirements of the business. Some idea of their present immense proportions will be gained from a glance at the sketch of the Works given on one of the following pages. It would be futile to attempt a description of the factory, seeing that within its boundaries there are altogether between 300 and 400 workshops. Nor would it be possible to enumerate all the different branches carried on; suffice it to say that every process connected with the fabrication of iron and tinplate ware, japanned goods, and tinned, enamelled and galvanized wrought-iron hollow ware can be witnessed; and it would be necessary to spend days rather than hours at this huge factory if one would gain an intelligent appreciation of the business. As we passed from room to room, we must

confess that we were well-nigh bewildered by the multiplicity of the operations, the diversity of articles which we saw in course of manufacture, and by the whirr and clang of machinery revolving at a speed which it is impossible for the eye to follow. Machinery, which as already mentioned, was originally introduced in this trade by the late Mr. Griffiths, is brought very largely into requisition. The plant includes a considerable number of stamping machines, adapted to all classes and sizes of work, some of them producing stampings of four feet diameter; and there are altogether no less than seven shops devoted to this one branch. We noticed a long array of planishing machines for brightening, graining, and polishing the sheets of metal; also ingeniously-contrived and delicately-adjusted perforating machines; and many other varieties of steam and hand tools of a special character for working tinplate, copper, brass, iron, zinc, and German silver. Having regard to the limits of this article it is impossible to give even the briefest record of the manipulative processes followed in connexion with any one of these.

MR. THOMAS FOXALL GRIFFITHS.

In one part of the Works we noticed twenty pits for tinning, and as each article is passed through several successive baths, the thorough and effective covering of every part is insured. Here may be mentioned the superior enamel work in connexion with iron which is done by the Firm, this being one of their specialties. It is well-known in the Trade that these enamels are virtually indestructible, as they are affected neither by acids nor heat; while as a matter of course they are free from all injurious ingredients. Japanned work is another leading line, and to what extent this branch is cultivated is apparent from the fact that there are here in full operation some fifty japanning stoves.

Great importance is attached to the tasteful ornamentation of the goods produced,—a point brought into prominence on visiting the Lithographic Department. Here a staff of artists is employed in designing the ornamentation employed on japanned ware, sign plates, tea trays, &c., and the effects obtained are in many cases of the highest order, and the decorations adopted for the best class goods are entitled to rank as real works of art. The press-room proper, where the transfers are produced, resembles a good-sized lithographic establishment, there being at work several steam-presses in addition to about a dozen hand-presses.

Space fails to go into further detail concerning the factory, as we wish to allude to some of Messrs. Griffiths & Browett's productions. These include such diverse articles as dish covers, cruet frames, tea and coffee urns and pots, lanterns and lamps for household, railway, and ships' use, meat screens, oil and spirit pumps,

WORKS OF MESSRS. GRIFFITHS AND BROWETT.

coffee roasters, toilet sets, every kind of hip, sponge, foot, and shower bath, bonnet boxes, oil cans, washing machines, portable cooking stoves, saucepans, jelly and other moulds, hot water plates, frying pans, dairy utensils candlesticks, nursery panakins, chimney guards, ladies' dress boxes, wicker plate baskets, coal vases, grocers' canisters, sample vases, show bowls, and other fittings, wash-hand stands, knife trays, dressing cases, cash and deed boxes, watering pots, travelling boxes and trunks, prospecting or gold-washing pans, flesh forks, ladles, &c. Even this long enumeration gives but an outline of the Firm's manufactures, and a mere list of them would fill some pages of this work. It must be also remembered that the various qualities and styles of each article are numerous. Even their comprehensive catalogue—a volume nearly two inches in thickness, and containing many thousands of illustrations—does not exhaust the subject, since a great number of specialties are made for different export markets. It is in this direction, indeed, that Messrs. Griffiths & Browett find a considerable outlet for their manufactures, and there are few countries in the world in which some of their specialties are not in demand; while among home buyers it is fully acknowledged that their productions are unsurpassed. We append a few illustrations as indicative of the character of some of their articles.

A few words may be said in conclusion as to the quality of the Firm's goods. Without exception they are characterised by excellence of material, solidity, admirable fitting, and thorough genuineness. The character of the ornamentation too is always adapted to the nature and purpose of the article beautified. There is uniformly displayed intelligence in design and best craftsmanship as well as good taste in execution. The present partners, Mr. Thomas Griffiths, Mr. W. F. Griffiths, and Mr. C. J. Browett, give their personal attention to the concern; and, as the indomitable perservance and mechanical ingenuity of the founder of this business was fifty years ago the means of resuscitating a dying trade, that has since developed into one of

our leading industries, so the careful attention to business and the readiness to adopt new and improved methods and processes which have been exhibited by subsequent members of the Firm, have secured that this business should throughout its history continue to advance with, or perhaps more correctly speaking, keep abreast of the times. Not only do their Works give employment to a large number of Birmingham operatives, but the Firm have benefited in another sense a far wider circle by bringing articles combining to a singular extent the useful and ornamental within the reach of all classes of the community.

In addition to their Birmingham Works, the Firm have branch offices at 21, Moorgate Street, London, and at 42, Rue Servan, Paris.

Messrs. J. & F. Bell, Glasgow.

TOBACCO—of which philosophers have raved and poets sung—is now almost universally used, and considered, by those competent to form an opinion, to have a consumption quite on a level with that of salt. All countries and all peoples are solaced and soothed by the fragrant plant, while the revenue derived by European Governments forms no small item in the State's resources. In the United Kingdom, for example, the quantity of unmanufactured or Leaf Tobacco that passed into the hands of manufacturers during the year 1886 was 50,972,001 pounds, which realised to the State £8,931,250. 6s. sterling.

The date of the introduction of tobacco into this country is somewhat involved in obscurity; probably it was first brought into England through the medium of the London merchants trading to Cadiz. On its introduction, tobacco was first used as a medicine, and was prescribed for almost every disease to which flesh is heir, and even up to and long after the Plague of London as an antiseptic and preventative.

Virginian Tobacco, which has long held sway as the best in this country, was first introduced during the reign of Queen Elizabeth, in the year 1586. Prior to that, in 1584, the Queen had granted a patent to Sir Walter Raleigh for "making discoveries in heathen and barbarous lands, and territories not governed by Christian princes." In pursuance of this, an expedition was fitted out in 1585 under the command of Sir Richard Grenville, who, after settling a colony, returned to England, leaving Sir Ralph Lane as Deputy-Governor. The colony was unsuccessful, and Lane returned home, landing at Plymouth and bringing tobacco with him.

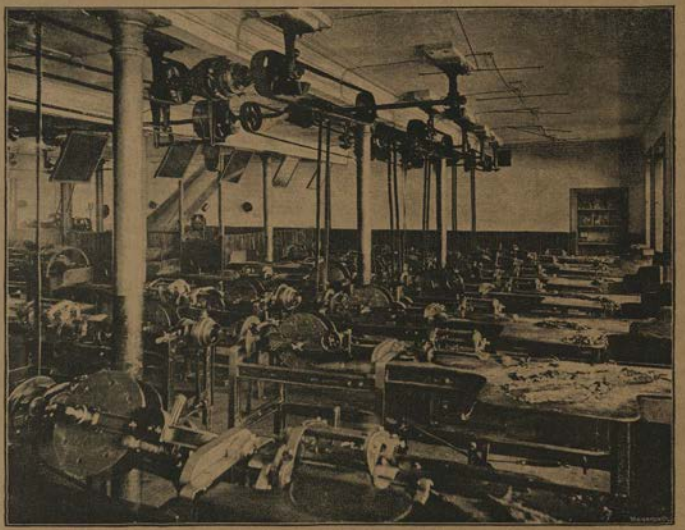
The habit of smoking during the reign of James I. had become so general among all classes, and even among the fair sex, that the Defender of the Faith became so horrified that he published his famous "Counterblaste." However, as this had no deterring effect, he imposed a very heavy tax of six-and-eightpence per pound in addition to the usual custom of twopence. He further prohibited the cultivation in England, Wales, and Ireland, at the instance and in the interests of the Treasurer and Company of Adventurers and Planters of the City of London for the Colony of Virginia; but all was without effect. His son Charles prohibited its growth from time to time, and the Commonwealth did likewise. But it was not until the time of Charles II. (1671) that the growth was *finally* stamped out in England and Wales, Guernsey, Jersey, Ireland,* and Berwick-upon-Tweed, under heavy pains and penalties. This Act has been in full force till recently, when permission was granted for cultivation under certain conditions. To Scotland the Act of Charles II. did not apply, and it was only in 1782 that the restriction was extended.

The cultivation in England during the seventeenth century was evidently extensive as authors of that period make mention of over six thousand plantations devoted to its growth in those counties which were suitable, such as Gloucester, &c.

* The Act was repealed in Ireland 1779. At that time, and until 1832, tobacco was cultivated, when it ceased.

MANUFACTURE.—The tobacco industry in the United Kingdom has increased considerably within the last fifty years, and has kept pace with the increase of population. The number of manufacturers, according to the last return, was 435 for England, 79 for Scotland, and 47 for Ireland, making a total of 561 for the United Kingdom. In England, the manufacture is chiefly confined to London, Liverpool, Bristol, Stockport, Manchester, and Newcastle; in Scotland, to Glasgow, Edinburgh, Aberdeen, Dundee, and Kilmarnock; and in Ireland to Belfast, Dublin, Limerick, and Cork. The largest of these centres are London, Glasgow, and Dublin.

The products of unmanufactured or Leaf Tobacco are Roll, Cut, and Plug Tobaccos, Cigars, Cigarettes, and Snuff. A few manufacturers only produce all these varieties. The staple productions in England are Cut Tobaccos and Cigars; in Scotland and Ireland, Roll Tobaccos.



VIEW OF A PORTION OF THE SPINNING SECTION.

The Firm selected for the ROYAL ALBUM OF ARTS AND INDUSTRIES is located in Glasgow, and is well known throughout the country, particularly Scotland. They cannot boast of great antiquity, although the business conducted by Messrs. J. & F. Bell was established at the close of last century. All the products mentioned are manufactured here with the exception of cigars, which branch they intend shortly to add. The factory and warehouses are situated in Brunswick Street, and consist of six floors.

As it may be interesting to our readers to know a few of the mysteries in connexion with the manufacture of tobacco, instead of ascending the stairs we will make use of the hoist, which raises us smoothly and speedily to the sixth floor. What strikes us first is the number of hogsheads of Leaf and Stemmed Tobaccos of the various growths of the United States. These we find upon examination to be the best qualities that can be got for spinning, and from which they manufacture their well-known "Imperial Roll." There are also hogsheads of golden colour and delicate aroma, which are used in the manufacture of the Firm's specialty, "Royal Navy Cut," which is smoked all over the Kingdom.

As Leaf Tobacco is imported in a dry state, it is necessary that the utmost care be taken in separating the leaves. This is done by moistening the tobacco with water and allowing it to remain until in a suitable condition. Here may be seen girls at work, selecting leaves for the various brands of cigarettes. At one time this work was done by men, assisted by boys, but since 1874 the trade has undergone a complete change. The leaf, when in a suitable condition for spinning and cutting, is removed to the floor underneath, where girls are seated before benches engaged in opening up the leaves, withdrawing the mid-rib, and classifying according to the colour and size required for the varieties of Roll, Plug, and Cut Tobaccos. The stems being removed, are now placed in a loft, where they remain until required for the manufacture of snuff. Here also the stocks of what are technically known as wrappers and fillers are stored. On the top floor of the adjoining building, which we now enter, the operation of plug-making is in full swing. The machines used are of American manufacture, by Brinkop, Quiney, Illinois. The plugs are manufactured at the rate of about 600 per diem by each machine. They are then covered and removed to the pressing section, where they are placed in frames and subjected to very great hydraulic pressure. Here the Firm produce their well-known "Golden Bar" and "Plug," of which they are the original manufacturers.

The fourth floor consists of the Spinning and Rolling Sections. There are twenty-nine spinning machines at work, made by the well-known Andrew, of Stockport, and of which a sketch is given. Each machine requires four hands, all girls, and produces from 800 to 3,000 pounds per week, according to size of twist. The chief production here is what is known as "Thick Roll." The rolls are then removed to the Cording Section on the third floor, where they are completed preparatory to pressing. This (third) floor consists of, besides the Cording Section, the engineer's room, and the counting-house in connexion with the manufacturing department. The engineer's room is fitted up with every appliance for effecting repairs of the machinery, two engineers being employed. In the counting-house we were surprised to find that the work was being conducted entirely by girl clerks. We understand that Messrs. J. & F. Bell are an exception to the trade, book-keeping being an important feature, and all their operations being carried on by double entry, the manufacturing department requiring twelve clerks.

The manufacture of snuff requires great personal attention, both in the selection of the tobacco and the process of fermentation. It is commonly thought that the use of snuff is on the decline; but, from information supplied by this Firm, one is forced to change his opinion. The snuff principally manufactured by the Firm is "Bell's Scotch." It is of a rich brown colour, moist, and possesses all the qualifications to please those who desire an article of quality and pungency, and, as a natural consequence, the demand is large. They also produce a large assortment of flavoured snuffs to suit all tastes, which are packed in tins on this floor.

On the first floor the pressing and cutting operations are conducted, and as Roll Tobacco is the staple for Scotland, the space devoted to pressing is most extensive, there being thirty-eight presses in operation, which are hydraulic, worked by steam-power, and containing from 300 to 4,000 rolls. These rolls, we understand, remain under pressure from four to eight weeks, in order that the tobacco may be thoroughly matured and acquire that flavour which at once stamps it as that manufactured by J. & F. Bell.

The machines in use for the cutting operation are those of Legg and Clarkson, and cut tobacco to any size. The cut tobaccos in which this Firm excel are known as "Bell's Special," which is a mixture of choice growths, and "Royal Navy Cut." This article can stand on a par with any of the high-priced goods that come from the United States and Canada, and is worthy of the consideration of those smokers who encourage the foreign manufacturers. There are numerous other choice brands, as the "Three Bells Smoking Mixture" and "Columba Mixture." The tobacco for cigarettes is also cut here, and a few words might be said on the delicate little rolls of tobacco wrapped in the finest "Papier de Riz."

A cigarette, we understand, is an article which is at one time exclusively supplied by Continental manufacturers, and latterly by those of the United States. But this Firm, like many others, are making them, and the success that has attended their introduction is very encouraging. They have special brands, such as "Los Angeles," "Carolina," and "Brunswick." They do not wish to increase the price of these goods by costly labels, but rather to put the quality in the cigarettes. It is only for a sensible, discerning public to appreciate their efforts. The finished tobaccos all converge into the warehouse on the second floor, where they are arranged, weighed, packed, and dispatched. The offices are also here, the counting-house work being carried on by female clerks, as before-mentioned. The number of hands employed by the Firm is 250.

It will be seen from the foregoing that the work in connexion with the preparation of tobacco is not only complicated, but passes through a great many stages before the tobacco is ready for the pipe.

Messrs. H. W. Caslon & Co., London.

EXACTLY two centuries and a-half have elapsed since, by a decree of the Star Chamber, the number of "Master Founders of Letters for Printing" allowed to practise their "art and mystery" in this country was reduced to four, the number of master-printers being at the same time limited to twenty. Oppressive as was this decree, its provisions were nevertheless embodied in an Act of Parliament passed in 1662. This Act extends to twenty-five clauses, and, while professing to be drawn up "for the better encouragement of the art and manufacture of Printing," it goes into minute particulars as to the number of apprentices to be employed, and, what is more extraordinary still, enjoins "the several master-founders of letters to take special care that all journeymen-founders of letters for printing be set on work and employed in their respective trades . . . . . although such master-founder of letters with his apprentice be able without the help of the said journeymen to discharge his own work!" The penalty for contravention of this clause was £5, which represented double, if not treble, the value of that sum now. Evidently they had a very summary way of finding work for the unemployed in those days!

Enactments of a similarly mischievous nature continued to disgrace our Statute-book for long after, and were, no doubt, to a large extent responsible for the deterioration which characterised the productions of British Typefounders down to the beginning of the eighteenth century. Indeed, our printers had in the main to depend upon type imported from Holland, and it has been truly observed that the glorious works of English literature which immortalised the reign of Queen Anne were originally presented to the public through the medium of Dutch types. Things were in this unsatisfactory state when there arose a genius who wrought such a revolution in the art of Typefounding as continues to make itself felt even in the present day. This great reformer was William Caslon, whose portrait,—the same as that which appears in Hansard's "Typographia,"—is given on the next page. He was born in 1692 at Hales Owen, Shropshire, and was by profession an engraver of gunlocks and barrels, carrying on business in Vine Street, near the Minories. He did not, however, confine his ingenuity to this branch, but was occasionally occupied in making punches for bookbinders, and one of these punches happened to attract the notice of Mr. John Watts, a leading printer of the day, who recognised its excellence and neat finish, and rightly conjectured that its author was capable of higher-class work, such as the cutting of punches for typefounders.

Encouraged by two or three of the foremost printers of the period, William Caslon, who in 1716 had commenced cutting punches, in the year 1720 set up business as a typefounder in Helmet Row, Old Street. Thence he removed to Ironmonger Row, and about the year 1735 to No. 22, Chiswell Street, where the business, established 167 years ago, is still carried on under the title of H. W. Caslon & Co.

Mr. Caslon applied himself assiduously to his new pursuit, and soon acquired a high reputation. In the year 1720 the Society for Promoting Christian Knowledge decided to print the New Testament and the

Psalter in Arabic, and the work of cutting the necessary fount of type was entrusted to Mr. Caslon, who acquitted himself of the work in a most creditable manner. Many other founts of Oriental and English characters were cut by him, and all were characterised by a legibility, symmetry of face, and excellence of finish that left the productions of his competitors far behind. His types were in demand far and wide, and few works of importance were issued in this country during the remaining portion of the eighteenth century that were not printed with his types. The perfection to which he brought the art of letter-founding has been universally acknowledged. Baskerville, himself one of the most renowned of modern printers, acknowledges Caslon to have been the greatest master of the art; Rowe Mores, another high authority, styles him the Coryphæus of modern letter-founders; and Lemoine, a French printer and writer on Typography, awards him the title of the English Elzevir. We might go on enumerating other equally flattering tributes; but, after all, his works may be left to speak for themselves, for no one can examine them, or, for that matter, the modern productions of the Caslon Foundry, without endorsing all the eulogiums that have ever been passed upon the work of the Caslons.

The high reputation which Mr. Caslon enjoyed induced the King (George II.), about the year 1750, to place him on the Commission of the Peace for Middlesex, which office he filled with honour to himself and advantage to the community. Some years previously, in 1742, he had been joined in business by his eldest son, who by way of distinction from the father is known as William Caslon II. Having seen the business well started on its successful career, the elder Caslon retired from its active management, and after having enjoyed some years' rest he died in 1766, aged seventy-four. Fresh energy and sound knowledge were brought to bear upon the Typefoundry by the son, under whom it continued to expand and prosper. He died in 1778, at the age of eighty-five, and both father and son lie buried in the churchyard of St. Luke's, that being the parish in which the business has been carried on from the beginning.

A third William Caslon, grandson of the founder, next took the management of the business, and his efforts, too, were rewarded by continued prosperity. He, like his predecessors, used his utmost exertions to further perfect the art, and he made his mark by introducing, in 1784, cast ornaments—the first made by an English firm. His efforts met with Royal recognition, for George III. appointed him in the following year "Letter Founder to His Majesty."

It would occupy too much of our space were we to attempt to trace from generation to generation the descendants of the first three Caslons. We must content ourselves by saying that each of the successors in turn made his influence felt, and contributed materially to foster this particular branch of manufacture. By close application, unwearied industry, and the exercise of artistic faculties, those who have presided over the Caslon Foundry have freed English printers from the necessity of importing type from abroad. But more than this, the productions of the Caslon Foundry deservedly rank among the foremost types for elegance, uniformity, and clearness, and they will bear a successful comparison with those of any other foundry. In Romans as well as Italics, in Jobbing founts no less than in Broadside type, alike in Initials and Ornaments, the Caslon Foundry stands well-nigh unrivalled, whether as regards the good taste of the design or the excellence of execution. Under the able administration of its present head, Mr. Thomas W. Smith, the establishment seems, after an existence of nearly two centuries, to have but renewed its youth, for it is from Chiswell Street that every now and then still emanate some of the most striking and pleasing novelties in Type and Ornament.

Foreign and Colonial printers, too, recognise and appreciate the merits of the Caslon Foundry; while instead of obtaining our type from abroad, as was the case when William Caslon started in business, the productions of that very same establishment now find a ready market on the Continent, and, in order to be able promptly to supply the foreign demand, the Firm have a branch house at No. 35, Rue Jacob, in Paris.

Globe Parcel Express, London, &c.

IMMENSE benefits have been conferred upon civilised nations by the establishment and development of that invaluable institution, the Post Office; but admitting this to the full we cannot but own that we are much indebted also to such institutions as the one to which this article is devoted. There are many points at which the Postal arrangements fail to meet the requirements of modern civilisation; and here the Globe Parcel Express steps in, and ably supplements the services of the national institution. The Post Office, of course, carries only comparatively small parcels; and herein lies the great advantage of a Parcel Express, by which packages of large dimensions may be forwarded to any part of the country or of the world.

It would be difficult to name a country or considerable district in any quarter of the globe having the slightest pretension to civilisation, to which rates are not quoted by the Globe Parcel Express. Not only are all parts of the United Kingdom, and countries of first-rate importance, such as France and Germany, and the United States, mentioned in the pamphlet which the Company issue; but even such remote places as the Sandwich Islands, the Cape de Verd Islands, the South Pacific, Abyssinia, and Japan are included also. The hundred and seventy or one hundred and eighty London receiving-houses render it impossible for any one residing or carrying on business in London or the suburbs to be far distant from one or other of them; but even greater facilities are afforded by means of the vans, which deliver goods in all parts of London many times daily, and which call for parcels also on receipt of instructions by post-card or telephone at the chief office in St. Paul's Churchyard. Passengers' luggage among other things can be collected, and forwarded to all parts whether at home or abroad. The rates for transmission are calculated on the lowest remunerative basis; and we should mention that on account of extensions made not long since in the foreign Parcel Post service, the Globe Parcel Express Company revised and reduced their tariff of parcel rates, and rearranged it with a special view to meeting the increasing demand for cheap conveyance of small parcels to all parts of the Continent, India, the Colonies, &c. We ought also to mention that, instead of compiling rates wholly by weight or wholly by measurement, the public are now offered the advantages of both these systems. Special arrangements can be made for the delivery of parcels in large numbers at a reduction from the ordinary rates.

The Globe Parcel Express Company also insure goods committed to their care if the sender wishes it. Every facility is offered for the dispatch of parcels in large or small numbers; and where business houses are frequently dispatching goods by the Parcel Express, the Company's vans will make regular daily calls without extra charge. But for further particulars concerning the dispatch of parcels, we must refer any of our readers who are interested in the matter to the pamphlet already mentioned, from which the fullest information may be obtained on all points connected with the operations of the Globe Parcel Express. Among other things, a list will there be found of the average lengths of voyages to the principal foreign parts.

Mr. William Whiteley, London.

MR. WILLIAM WHITELEY, known all over the British Empire as "The Universal Provider," is one of the most remarkable of the many princes of commerce this country can boast. During the latter half of the reign of Queen Victoria he has built up an establishment which has no equal in the world. By dint of his remarkable power of organisation, his unflagging perseverance, and his straightforward principles, he has secured the patronage of a large percentage of the best families in the United Kingdom, many of whom never dream of making a purchase away from the great establishment which bears the honoured name of the subject of this notice.

Mr. William Whiteley was born on September 29, 1831, near Wakefield, Yorkshire. He finished his school days in his fifteenth year, when he turned his attention to farming. After two years' training in agricultural pursuits, young Whiteley apprenticed himself to a silk mercer. At the expiration of this term of service he felt that Wakefield was too small a field for his future operations. The youth was ambitious. While he was serving his apprenticeship he doubtless built many *châteaux en Espagne*, little dreaming that his ideals would all become substantial realities. With only £8 in his pocket he reached the great Metropolis, and lost no time in procuring an engagement with a City firm, in whose service he remained for a period of fifteen months, after which time he transferred his labours, without a day's intermission, to the largest wholesale drapery warehouse in the world, viz., that of Messrs. Morrison, Dillon, & Co. Two years and a-half later he was, by reason of most liberal offers, tempted to return to Wakefield, at the solicitation of one of the partners of the house by whom he had been originally employed. Finding, however, that the country offered only a restricted area for the exercise of his sleepless energy, he resolved, after an absence of three months, to again make his way to London, where he reverted to his original position with the great Fore Street firm, with whom he did duty for another period of two and a-half years. At the end of this time, induced by most advantageous terms, he devoted his energy to the development of the business of Messrs. Green & Graham, with whom he became associated for a period of three and a-half years. On the dissolution of partnership of this firm, having accumulated a small capital, he began to consider the advisability of entering business on his own account. Perceiving, however, the pear was not yet ripe, he now entered into very lucrative employment in the great firm of Messrs. Bradbury, Greatorex, Beall, & Co., in whose service he remained for a term of twelve months.

In March, 1863, according to a writer in a number of *St. Stephen's Review*, to whom we are indebted for the biographical data of this remarkable man, Mr. Whiteley, in the possession of the highest character, on account of probity, energy, and capacity, and of an experience in business covering fifteen years, commenced the second stage in his career. Had any prophet attempted to make a forecast of the future, and pictured the actual facts in relation to his life, the seer would have been deemed a lunatic. Outside the stories of

mere romance there is no other rise so marvellous and no progress so rapid as that recorded in respect to William Whiteley. Speculators in mining properties may have wrested fabulous sums from the clutches of mother earth, aided by the magic of good luck, but what other man by the means of simple retail trading has ever achieved what he has accomplished? Cautious yet daring, sure-footed yet fleet, he has not only distanced in the race of enterprise all other retailers on the face of the earth, but has initiated a system which while being profitable to himself has been far more profitable directly and contingently to society at large. It seems nearly beyond belief that an individual who commenced to do business with an insignificant capital, in cramped premises, less than twenty-one years ago, should now be the greatest prince of retail commerce in the world, and that he should have come to this distinction not because he had connexions who lent him aid, but by reason of an unconquerable will and gifts, which had they been employed in any walk of life must have brought him pre-eminence.

Opening a small shop with two employés, at the beginning of the second year of his occupancy he found himself in the command of a staff numbering eighteen. At the end of four years Mr. Whiteley took a new departure, and, by the addition of fresh premises, he was enabled to enlarge the scope of his operations by fully developing his business in respect to every kind of drapery materials. From that time to the present, house has been added to house, premises to premises, so that now a vast pile of buildings covering many acres of ground, with multiplied fronts, north, south, east, and west, stands as perhaps the greatest monument of its kind ever raised in evidence of single-handed enterprise. Mr. Whiteley has been not inaptly called the Wizard of Westbourne Grove, yet no magician has ever created so successfully.

Leaving this prince of commerce for a while we will take a peep at his dominions and endeavour to prepare the reader for the treat in store for those who have never visited "Whiteley's." We have often acted the cicerone for our country friends and led them through this wonderful store, which may justly be termed one of the sights of the Metropolis. In spite of our having played the showman so many times, we could not pass Whiteley's without taking a stroll round. Persons who are satiated with exhibitions will always find something novel and attractive at the Universal Provider's great show. One is accustomed to expect a great deal at a much-vaunted and well-advertised "World's Fair," and often one feels disappointment because the laudatory advertisements and reports stretch the mind to the highest degree of expectancy, far beyond the power of realisation. But the visitor who is conducted over "Whiteley's," not having been prepared by a single clap-trap advertisement, and only expecting to find a very large "shop," leaves Westbourne Grove filled with wonder, and votes the great emporium as one of the best shows in London. Such has been the impression always made upon the ladies and gentlemen who have taken our advice and paid Whiteley's a visit; they have always found everything so different to what they have expected. Ladies, particularly those who have had experience of "pushing tradesmen," after hearing so much about the energy of the Universal Provider, may fancy that the place is filled with those *bêtes noir*, "pushing shopmen," who worry the lives out of customers and force them to buy articles they do not require. We are almost inclined to believe that a share of Mr. Whiteley's success is in a measure attributable to the total absence of vampire shopmen. It seems almost incredible, but it is nevertheless a fact, that a lady or gentleman can walk through every department of Mr. Whiteley's great establishment, stop and admire the thousands of articles there displayed, and walk out again without spending a penny and without being asked a single question. Our commercial prince will not allow even the managers of the departments to do more than direct visitors who may not know the route to any particular part of the building; the consequence is that men who would rather face an enemy armed to the teeth with ball cartridge and fixed bayonets than run the gauntlet of a dozen pushing salesmen, may be seen any day quietly strolling through "Whiteley's" without fear of molestation, and they must be poor as church mice or natural misers if they can leave Westbourne Grove or Queen's Road without carrying away a souvenir of the world-famed emporium.

Although Mr. Whiteley commenced business as a retail draper and silk mercer, it would now be difficult to name any branch of commerce which he has not mastered. He has well earned the title of Universal Provider, for it is a well-known fact that he undertakes to supply anything that money can purchase. Aye, more! we have heard on good authority, that on one occasion he provided a gentleman with a wife, and our knowledge of Mr. Whiteley leads to believe that the "Wizard" did not get a profit on that delicate transaction. The old saying, "for love or money," may justly be applied to Mr. Whiteley's system of doing business, since he is able to control the matrimonial market as well as the various branches of commerce.

Starting from the original shop, which is now exclusively devoted to the hat department, we next

reach the tailor's shop, where experienced and faultless cutters may be seen busily engaged upon the patterns of all kinds of male apparel. Adjoining the tailor's is the hosiery department. Upstairs are rooms filled with all kinds of dressing-gowns, plain and fancy shirts, and other articles worn by gentlemen; while, on the ground floor, small things for the toilet, such as ties, collars, gloves, studs, and sleeve-links, may be seen in every variety. Leaving the hosiery department, we soon find ourselves in the ladies' outfitting shops, and then a short passage opens into a long shop devoted to dress materials of all kinds; near the end of this shop, on the left hand side, is an opening which leads to the counting-house, information-office, bank, opera, concert, and theatre box-office. Passing on, we enter another long shop set apart for the display and sale of every description of ladies' hosiery. Through this department and we reach the lace-shop, where real and imitation Maltese, Honiton, Valenciennes, Brussels, and other kinds of lace may be purchased. Next we pass through the dressmaking department, the jeweller's shop, the boot and shoe store, the ribbon-shop, the calico department, and the building devoted to the stationery and book trade. Here may be purchased, at

MR. WILLIAM WHITELEY.

moderate prices, the many articles now in use for the writing-table, also a splendid assortment of portraits of eminent actors, actresses, statesmen, clergymen, professional beauties, and other distinguished persons, offered for sale at much less than the original photographers would charge for the pictures. The book department is well-patronised, for Mr. Whiteley offers advantages to book buyers not to be obtained elsewhere. In addition to the twenty-five per cent. discount allowed by the large City bookseller, the Universal Provider undertakes to deliver a book, no matter whether it costs twopence-halfpenny or three guineas, free to any part of London or the suburbs. To give the reader an idea how this department is managed, we will cite our own experience. We have on many occasions sent an order on a postcard for a cheap novel, published, say, at a shilling. Each time, before the day was over, we received a postcard acknowledging the receipt of our "esteemed order." The following day the shilling book was delivered at our residence—a long way from Westbourne Grove—and ninepence was the total amount we had to pay. The ribbon, calico, and book departments open into a spacious shop, where ladies' costumes are artistically displayed by well-dressed attendants, who are noted

for their courtesy and untiring patience. Passing the long row of dresses and mantles, we reach the hair-dressing saloon, which contains rooms for ladies and gentlemen; and beyond this is the restaurant, where customers dine or take refreshments when they begin to feel the fatigues of shopping. In front of the restaurant is the wine and beer department, and the Westbourne Grove shops end with the drug store.

In order to go from Westbourne Grove to the palatial shops in Queen's Road, we have no occasion to leave the premises belonging to Mr. Whiteley. There is a long passage lined with pictures leading to the Queen's Road, which is reached in about two minutes. If the Westbourne Grove shops strike the visitor with wonder, what effect must the magnificent structures in Queen's Road have upon him? Such shops as these erected by Mr. Whiteley have never been equalled. The first is devoted to provisions. It is large enough to contain butcher's, poulterer's, fishmonger's, butter and cheese, cooked meat, and greengrocer's shops, besides an oyster luncheon bar. The provisions are of the very best quality, and the prices much less than they are ticketed in other good shops. Epicures delight in a stroll through this department. The scrupulous cleanliness and the admirable manner in which the choice viands are displayed suffice to create an appetite, and make one long to try the dainties laid out in endless variety.

The man who is cursed with a bad cook must, indeed, rejoice in such an institution as Whiteley's. If he wishes to give a luncheon, a supper, or a dinner party to his special friends, he need not risk a fiasco. He can spare his own and his *convives'* digestive organs by paying a visit to the provision department and selecting the dishes, or giving an order to the manager to supply the dinner, supper, or luncheon, either with or without plate, glass, wine, and floral decorations. After lingering long in the provision store, we pass on to the grocery establishment—another huge shop—down one side of which is to be found everything sold by an "Italian warehouseman," and on the other side there is as fine an assortment of English pastry as one need wish to see. Here is a row of pretty girls, dressed in black with white facings and snowy caps, serving biscuits, tarts, pies, puddings, and cakes of all kinds. The pastry is all made below, in the cleanest bakery ever constructed. Male cooks only are employed to design the "sweets" for the table.

Between the grocery and metal departments is the Floral Hall, which contains, in addition to a lovely display of flowers and ferns, globes of gold and silver fish, and cages filled with domestic animals. Groups of ladies may be found any day admiring and petting the toy terriers, Persian cats, marmoset monkeys, and the other inhabitants of this pretty menagerie. The floral hall on one side opens into the metal department, which contains a magnificent assortment of ironmongery and fancy brass-work. The china and glass shops are next reached. Here are displayed the choicest specimens from the Staffordshire potteries; from Meissen, Sèvres, Vienna, and Prague; also a splendid gathering of ceramics from Minton's and the Worcester Works, the Royal Crown Works, Derby, the Belleek Works; Ginori of Doccia, fatence of Doulton, modern Grès de Flandres, Hispano-Moresque; all the crystals of Webb of Stourbridge, Lobmeyr of Vienna, Murano glass of Salviati, &c., &c. After a careful examination of the many lovely works of art in this department, we make a halt at the French confectionery "Magasin." This is a favourite resort in the summer time of both sexes. At the end there used to be a bar where American drinks and ices were served, and so great was the rush to this spot in the broiling weather of July and August that the Hebes could not draw the nectar fast enough for the thirsty customers.

Now all is changed. The French demoiselles are left to serve their *bon-bons* and chocolate creams in peace. At the other extremity Mr. Whiteley has lately opened a sort of combination American bar and coffee-room, where the loungers can draw their cooling drinks through straws at their ease, and where ladies who do not care for ices can have a cup of tea or coffee without the trouble of journeying to the restaurant in Westbourne Grove. We cannot over-praise this valuable addition to the French confectionery department. It is light, well-ventilated, and handsomely decorated. The machinery used for the various kinds of "drinks" is of the very latest design, the attendance good, and the waitresses' fees *nil*. Let any of our readers who do not care for alcohol try a "lemon squash" at Whiteley's one hot summer's day, and he will never wish to drink another elsewhere. Reluctantly leaving the American bar, we soon find ourselves in the linen department, at the end of which is the coal and shipping offices, which open into the carpet stores and the building and decorating department. From the carpet to the Oriental department is but a few steps, and next we find ourselves in the furniture store filled with every variety of art furniture, including Early English, Jacobean, Queen Anne, Louis Quatorze, Adams, and Chippendale, from ebonised to pollard oak. Above these splendid stores are other departments devoted to ornamental lamps, basket-work, photographic materials, a photographic studio where sunlight is no object, electricity always being available when Sol is obscured by thick clouds.

The music-room is a "sight" in itself. We passed row after row of pianofortes, of English and foreign make, including Mr. Whiteley's own specialties. Adjoining the music stores is the hire department, where everything required for banquets or fêtes can be procured. Here we saw Punch and Judy shows, Aunt Sallies, convex and concave mirrors for rendering hideous the "human form divine," and for exciting the risible faculties of all who survey themselves in those distorting glasses.

We have briefly glanced at the important departments in Mr. Whiteley's vast establishment, but we have not referred to the basement, where the bakers and confectioners, fishmongers, butchers, poulterers, bottlers, packers, &c., work. The manufacturing and warehousing departments are under the shops in the Queen's Road. Tons of sausages are made per diem. In the "cellarage" we saw the mineral water men filling and stopping bottles by the hundred. Poulterers were drawing and trussing every description of bird in season. Butchers were cutting up joints enough to supply nearly the whole of Bayswater; and fishmongers were trimming the fish for the wealthy customers of the Universal Provider. In the warehouses we saw scores of young men packing goods for delivery by vans and carts and railways to all parts of the kingdom. In fact, there was too much to be seen in so short a time,—the magnitude of the place was so impressive, and its labyrinth of cellarage passed before us in such rapid panoramic fashion on the occasion of our privileged visit,—that we had barely time to note, even in our mind's eye, all the treasures of the great Emporium. The workshops in connexion with the building trade are large, and fitted up with modern machinery, including a number of lathes. There is also a big printing shop, where a number of compositors are employed.

THE ELECTRIC LIGHT AT WHITELEY'S.—Mr. Whiteley never passes by a new discovery or invention without giving it a trial. He first makes himself thoroughly acquainted with the principle upon which a new contrivance acts, that is, he finds out the particular "go of it," and then if he is satisfied that its introduction will benefit his patrons and increase his business, he spares neither labour nor expense to accomplish his purpose, whatever may be the object in view.

Although millions were sunk while the electric lighting mania lasted, and public confidence was destroyed, in spite of the opposition on the part of legislation to the development of electric lighting, Mr. Whiteley knew that after the bubble burst, and when public confidence was again restored, the electric light would be the light of the future. He accepted it for the present as a luxury, and he set to work to introduce it in his own establishment on a scale hitherto unattempted in this country. His chief engineer—a man of great experience—turned his attention to electrical engineering, with the result that Mr. Whiteley can now boast of possessing the largest electric light installation in England. We will conduct the reader to the engine-room, and briefly describe the plant to be found there. To begin at the beginning is to begin with the boilers; they are two in number, of the Lancashire type, and provided with every modern appliance, and are fed by pumps on the main engines, and a donkey-pump drawing direct from the mains of the water company. These boilers have to produce a great deal of steam, besides that taken by the main engines. They drive a pair of winding engines, working a 1-ton hoist in the cabinet-making factory. They provide steam for fifteen great jacketted pans in the provision department, and for a multitude of purposes in several kitchens, where meals are daily prepared for many hundreds of employés. This work was done by gas before the boilers were put down. They also warm the floral hall, the zoological department, and various other parts of the premises. The feed-water is raised to a high temperature by the exhaust steam. The engines are two in number. They are horizontal, with cylinders 18 in. in diameter and 3 ft. stroke. They are placed side by side, and can be coupled or run separately at will. They are a very fine pair, and leave nothing to be desired in design or workmanship. They run at eighty revolutions per minute. These engines have to supply a great deal of power to the various workshops, and the demands made on them vary continually as machines are thrown on or off. The principal work done by one of them is to drive a great Ferranti dynamo, the same known as the "Thousand-lighter" at the Health Exhibition. This is provided with a Siemens' exciter, and supplies current for no fewer than 1,300 incandescent lamps. The machine and exciter run together at 1,200 revolutions. The "Ferranti" runs almost in silence, without sparking. The bearings are quite cool. There are, besides, other dynamos—thirteen in all—running every day. Before going on to speak further of the electric-lighting plant, it will be well to say that the engines supply power throughout the premises by means of a vertical shaft, which rises through five floors. From this line shafting is laid, which drives,—in the mineral water department, nine machines; in the provision department, five machines; in the bakery, twelve machines; in the gas-fitting shops, eight machines; in the building department, three wood-working machines; in the cabinet-making factory, six machines; in the pianoforte factory, three machines; in the printing-office, fifteen

machines; and in the wholesale grocery department, twelve machines. Further, there is a horizontal fan to keep the engine-room cool, chaff-cutters to provide food for the 300 horses employed by Mr. Whiteley in his delivery-carts, one 2-ton hoist, one ½-ton hoist, one 1-ton outside crane, and one ½-ton lift in the forage department, besides great length of shafting scattered all over the buildings. The engines usually indicate about 190 horse-power each.

The Queen's Road shops are lighted by Jablochkoff lights—seventy in number. The basement beneath is lighted by incandescent lamps run in parallel current, being supplied by Ferranti, Siemens', and Jablochkoff machines. Incandescent lamps are also used in some parts of the ground-floor, the floral hall, and the provision-shop windows. There are 600 lamps in all in this part of the premises. The Jablochkoff lamps are run five in series by 10 and 20-light Jablochkoff dynamos. Each lamp gives 370 candles—Board of Trade estimate. There are, besides, three large arc lamps — one in Queen's Road, one in Westbourne Grove, and one in Douglas Place. These are 1,200 candle-power lamps. There are thirty leads from the engine-room for this installation, and over twenty miles of wire. At the top of the house there is a most complete photographic studio, fitted with a huge electric light. When the operator wants the current turned on he presses the button of an electric bell, which rings in the engine-room, and calls the attention to the engineer in charge. There are six more leads from the engine-house for the Westbourne Grove premises—two for the basement, two for the ground-floor, and two for the first floor. On the last there are 300 incandescent lamps, and 800 on the ground-floor, supplied with current by the great Ferranti machine already noticed. The basement current is supplied by a smaller Ferranti, with a Siemens' exciter. Of the six leads, four consist each of nineteen No. 12 wires and two of nineteen No. 14 wires. The total length of wire used is fifteen miles.

To sum up, there are in all 2,000 incandescent and 100 arc lamps and sixty miles of wire. The *Engineer* of February 18, 1887, says:—"It is a notworthy fact that so many types of dynamo should be used, and that all seem to give satisfactory results. From personal examination, we can say that we have never seen better lighting, the incandescent lamps being without fluctuations of any kind. The professional electrician has had nothing to do with the installation, the whole being carried out by the maker of the steam-engines and Mr. Whiteley's own staff. The lesson taught is instructive. We have here, shall we say, a 'scratch team' of dynamos doing most excellent work. The whole installation from first to last shows that if proper precautions are taken to secure the requisite conditions, electric lighting may be made to compete with gas." In addition to the great emporium in Westbourne Grove and Queen's Road, Mr. Whiteley possesses the Manor Farm and Fallow Farm at Finchley, where he produces most of the hay necessary for his own quadrupeds, besides tares, mangold-wurzel, vegetables, flowers, cream, butter, eggs, beef, mutton, lamb, veal, pork, poultry, &c. The daily output of the products of the animal and vegetable kingdom coming from the farm necessitates the employment of five wagons, with, incidentally, other vehicles, all of which make a daily journey to Bayswater. The Universal Provider employs 6,000 persons, and controls the greatest retail business on the face of the globe.

In a biographical sketch which appeared in one of the leading reviews, the writer summed up the special gifts of Mr. Whiteley in the following words:—

"This remarkable individual is the Alexander of commerce. No sooner has he conquered one world than he organises a new campaign to bring another under his sway. Neither Cæsar, Hannibal, Napoleon, nor Moltke has shown more far-reaching powers of organisation. He bends all to his will by a cultivation of that order which is nature's first law. Curious to say, though he is essentially the greatest master of method in the old or new world, he is a man as full of gaiety as he is of sympathy. To him belongs the especial quality of insight. He anticipates popular tastes and popular wants, and it has been left to him to discern the signs of the times as no other trader in the British Isles. What he has conquered, what he has achieved, can only be known when it is learned that William Whiteley has never received loan nor favour, nor help in any form whatever, from relative, friend, capitalist, or banker, while on every occasion when money or property has been bequeathed to him he has refused to accept it. He has been all things to himself, and ever pursuing the even tenour of his way with an undaunted, gay, and buoyant front, has won a record in the history of commerce which, as the years advance, shall broaden and deepen, so that the name which is now a household one shall bear a lustre worthy of work done in simple trust in the principles of unpretending honour, loyalty, truth, and steadfastness."

Messrs. Dalton, Barton, & Co., Limited.

OCCUPYING an almost central position between the four great ports of London, Liverpool, Bristol, and Hull, the city of Coventry has, from an early period, enjoyed a great commercial reputation. Rich and varied almost beyond parallel are her historical and other associations, and they are, moreover, of such a nature as to appeal alike to all classes. The student of architecture will recognise in St. Michael's Church one of the finest examples of the Perpendicular style; while Trinity Church is equally noteworthy for its Later English architecture. The towers of these two churches, together with that of the Grey Friars, are conspicuous from a considerable distance, and form the "three tall spires" commemorated in the verses of the Poet Laureate. There are many other famous buildings full of interest, such as St. Mary's Hall, Bablake Hospital, Ford's Hospital, the Whitefriars' Monastery, and several more. The antiquary, again, may revel in the traditions that have for centuries clung to the place; one of which relates how Godiva

> . . . . took the tax away
> And built herself an everlasting name.

In some of the bye-streets, moreover, may still be seen a number of the old half-timbered houses projecting over the footway, and retaining the picturesque appearance of a past age.

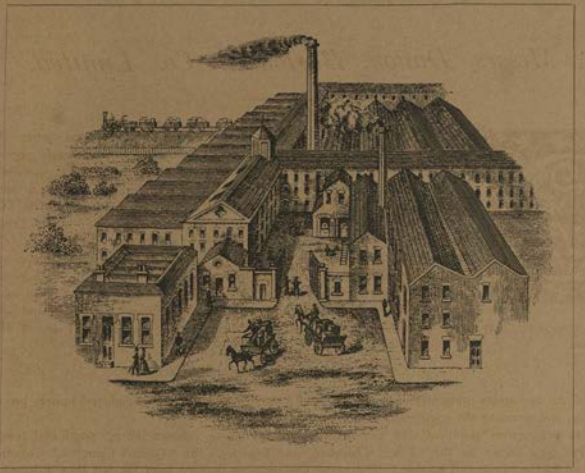
From yet another point of view, Coventry occupies a unique position among provincial towns. While London was once known as the "King's Chamber," and Bristol as the "Queen's Chamber," Coventry became distinguished as the "Prince's Chamber." The name was probably derived from the fact that Edward III. when, in 1337, he made the Black Prince Duke of Cornwall, attached the manor—then known as Cheylesmore—to the dukedom, and it continued the patrimony of successive Princes of Wales down to the early part of the present century. Henry VI. and his Queen, Margaret of Anjou, held their Court here for a considerable time. Edward IV. spent his Christmas there with great festivities in 1465; and the town has in turn been visited by Richard III., Henry VII., Henry VIII., Queen Elizabeth, James I., James II., Princess Anne of Denmark (subsequently Queen Anne), William III., and George IV. (when Prince Regent). In more recent times Coventry has been honoured by visits from Her Majesty Queen Victoria, in company with the lamented Prince Consort, and later still by the Prince and the Princess of Wales. Two Parliaments have also been held here in the fifteenth century, known in history respectively as *Parliamentum indoctorum* and *Parliamentum diabolicum*.

From the frequent patronage of Royalty extended to the town, it will thus be seen that there is an exceptional appropriateness in some of the chief industries of Coventry finding a permanent record in this "Album," issued to commemorate the Jubilee of the reign of our Gracious Sovereign.

Celebrated from an early date for her manufactures, Coventry has seen her trade undergo at different periods various important changes, so that some of her former industries only survive by name. Happily

for her prosperity, there have arisen among her citizens from time to time men who have been able to adapt themselves to the changing requirements of the times, and who, when certain local handicrafts decayed, have struck out fresh paths and introduced new industries. Prominent among the list of such Industrial Pioneers stands out the name of Robert Arnold Dalton, Esq., J.P., of Whoberley Hall, Warwickshire, and The Quadrant, Coventry. He, like the majority of our merchant princes, has been the architect of his own fortune, and his career is but another illustration of what can be accomplished by close application, indomitable perseverance, and great mental capacity. The story of his life is, therefore, well worth telling.

Born on March 1, 1825, Mr. Dalton was educated at Bilton, near Rugby. He then served a seven years' apprenticeship with Messrs. Sargeant Brothers, an eminent and well-known Coventry firm of ribbon manufacturers, by which term of service he became a freeman of the city. He next proceeded to London, and, with a view of qualifying himself as a merchant, he in 1846 entered upon a twelvemonth's engagement



MESSRS. DALTON, BARTON, AND CO.'S FACTORY, COVENTRY.

as salesman with Messrs. Ellis & Everington, whose business still survives, being now carried on under the title of John Howell & Co., Limited. In his capacity of salesman Mr. Dalton gave already evidence of his great business qualifications, which were fully recognised by his employers, who, at the expiration of the year, made him tempting offers to induce him to stay. He would not, however, be turned away from his resolution to start a manufacturing business in his native city. How well advised he was in taking this course, and how exceptionally he was fitted for the work he had set himself, is apparent from the fact that by the year 1850 he had built up one of the foremost businesses in Coventry, and taken rank as one of the largest local employers of labour. He had, some years previously, taken into partnership his brother-in-law, Mr. Barton, who, however, retired from the business in 1871, and died in the following year.

It is a well-known saying of Swift's, that he who makes two blades of grass to grow where only one grew before, deserves better of his country than the whole race of politicians put together. Regarded from this point of view, Mr. Dalton has indeed proved a great benefactor to his native town; for during the ten years,

1851–61, he introduced no less than three distinct new branches of industry, viz., the manufacture of Elastic Webs, of Upholstery Trimmings, and of Coach Laces, &c. To enable one to realise the importance of these new branches, and the degree in which they have contributed to the prosperity of the city, one need but recall the abject misery into which her working population was formerly plunged at every change of fashion, as, for instance, in connexion with the ribbon trade.

As the business continued to grow and develop, Mr. Dalton found the burden of managing the large concern too heavy, and he therefore, in 1875, converted the London branch house into a Limited Liability Company, under the title of Dalton, Barton, & Co., Limited. A noteworthy and highly commendable feature of the new arrangement is, that the heads of every department have a financial interest in the business, so that it is actually carried on upon the co-operative principle. This arrangement has been amply justified in its results; every one of the staff, from Mr. T. M. Hammerton, the genial and indefatigable Managing-Director of the

LONDON BUSINESS PREMISES OF MESSRS. DALTON, BARTON, AND CO., LIMITED.

London house, downwards, is actuated by an earnest desire to insure the continued prosperity of the Firm; and this end is attained by the good old-fashioned plan of producing and supplying only such goods as are unexceptionable alike for quality and workmanship. It is this policy of giving customers the best possible value for money that has insured for Messrs. Dalton, Barton, & Co. a world-wide reputation; so that their goods are in demand alike in the Home, Colonial, and Foreign markets, while their name is universally recognised as a guarantee of sterling worth. Mr. Dalton, we may add, continues still to be the head of the concern, although he no longer takes so active a part in the business as he did formerly.

To do justice to the extent and variety of the Firm's manufactures is more than we can attempt within the space at our disposal. They include the whole range of upholstery and carriage trimmings, as well as curtains, table-covers, furniture laces, &c. By mere description it is impossible to give an adequate notion of the wealth of chaste designs, rich colourings, and happy blendings of materials which are available in the various fabrics, gimps, and trimmings; but all alike attest the artistic power and technical proficiency which

preside over the manufacturing departments. Certain minor classes of goods are also produced in enormous quantities, such as address labels for underclothing, mantle and coat suspenders, boot loops, curtain and mattress labels, and military ribbons and laces, for the supply of which latter, and some other articles, the Firm are contractors to the Government.

A visit to the extensive works at Coventry gives one some idea of the large scale on which the manufacturing processes are carried on; while even more striking evidence to the same effect is afforded by a tour of the magnificent London warehouse and showrooms. The latter is a substantial building of six stories, specially erected by the Firm last year to meet the ever-increasing requirements of their business. This fine structure—of which an illustration is given on a preceding page—is situated in Jewin Street, Aldersgate Street, a thoroughfare which is classic ground by reason of its association with Milton, who is believed to have written in Jewin Street part of his "Paradise Lost."

MR. ROBERT ARNOLD DALTON, J.P.

This brief description of the business would be incomplete without some further reference to the man who not only laid the foundation, but was also mainly instrumental in bringing it to its present almost unrivalled position. As an employer, Mr. Dalton has ever been actuated by a spirit of generosity and kindly consideration for his workpeople, to whom he has thus naturally become greatly endeared. When, after some forty years of continued application, he in 1883 retired from active management, the occasion was taken advantage of by his many hundred workpeople to present him with a richly-illuminated address, in which his uniform kindness was acknowledged, as well as his continued effort to benefit those in his employ; while at the same time a devout hope was expressed that many years' health and prosperity might be still in store for him.

Mr. Dalton has not, however, confined his good deeds to those connected with him in business; his charity, while it commenced at home, did not end there. He has always been a generous supporter of every movement which had for its object the welfare of his fellow citizens, and the promotion of the common weal.

Although "a merchant of great traffic through the world," he has yet found time to serve his generation in many public capacities. He is a Justice of the Peace, an Alderman of the borough of Coventry, and a member of the managing committee of several local institutions for the promotion of educational and other benevolent objects. He has in turn filled every civic office, and in 1874 was elected Mayor. In commemoration of this event, he presented the city with a magnificent gold chain and badge of office, made by Messrs. Hunt & Roskell, of Bond Street, London. At the end of his year of Mayoralty, the Corporation of Coventry passed special votes of thanks acknowledging the zeal and impartiality with which the duties of the office had been discharged. What may be regarded as a still greater tribute to the ability with which he had filled the position, is the fact that both political parties united in desiring him to again assume the responsibilities of the Mayoral Chair during this the Jubilee year. While fully appreciating the exceptional honour which it was thus sought to confer upon him, Mr. Dalton was unfortunately compelled to decline to serve from purely domestic reasons.

From among the many acts of Mr. Dalton's liberality we will only mention one as affording evidence of his generous impulses. To the fund for restoring the far-famed St. Michael's Church—which work is now being proceeded with—he has contributed the handsome donation of £1,000. In the same church he has also placed a beautiful Memorial Pulpit, in commemoration of his only child, a boy thirteen years old, whom he had the great misfortune to lose in 1868.

The foregoing notes will suffice to show that the head of the Firm of Dalton, Barton, & Co., has ever identified himself with the local interests of his native place. In many other ways besides those already mentioned has he sought to benefit his fellow citizens, and notably by that most praiseworthy of all agencies, viz., by providing work for the artisan population. He has a considerable monetary interest in the local Gas Works, Cotton, Bicycle, and other manufactories, all of which have contributed materially to the prosperity of this good old "Royal" city. During his whole life, in public as well as in private, Mr. Dalton has sought to make the interests of others his own, and to let his fellow men be participators in the well-earned fruits of his toil. If, according to Dr. Johnson's dictum, those by whom we are most benefited should be most admired,—then Coventry has good cause to be proud of him whose commercial career has been the subject of our sketch.

Messrs. Wilkinson, Heywood, & Clark, West Drayton and London.

THE use of varnish for the purpose of preserving and giving a brilliant gloss to all descriptions of painters' work is of very ancient origin. It was known to the Egyptians and Greeks, and in the ruins of Pompeii have been found specimens of the decorator's art bearing unmistakable signs of having been beautified by the aid of varnish. The Japanese and Chinese have appreciated its value for ages past, as is evidenced in the application of many varieties of varnish to ingenious and artistic examples of their skill; and in these days, whether in the artist's studio or painter's workshop, we see the indispensability of varnish, the manufacture of which has become an important British industry.

The extensive Works of Messrs. Wilkinson, Heywood, & Clark, of West Drayton and London, may be taken as eminently typical of this industry, in the prosecution of which the Firm have always occupied the foremost rank. The foundation of their business was laid, upwards of a century ago, by a chemist named Pritchard, who established himself in premises on the site of the present Works in Caledonian Road, King's Cross. In addition to the manufacture of drugs, he also produced varnish, naphtha, and various oils, and from all accounts carried on a profitable trade. In those days, the lighting properties of naphtha were little known, and Mr. Pritchard was the first to adapt them to the purpose of illuminating the London streets. It is noteworthy that the vessels he employed are still utilised at the West Drayton Works. The present business owes its origin to a Captain Tucker, who purchased Pritchard's interest, but as the Captain had some disinclination to appear as a trader before the public, he induced his foreman, Thomas Wilkinson, to allow the concern to be carried on under his name. Captain Tucker's influence was exerted in introducing the varnish to the notice of the leading carriage makers, but as its manufacture improved with time, it held its position and made fresh headway on its own merits. The steady increase of the business in London led to the establishment of the Works at West Drayton, which are situated conveniently near the Great Western Railway and the Grand Junction Canal, the latter being the principal means of transit to and from the manufactory.

The raw materials for the varnish consist of gums, turpentine, and oil, which, being delivered at the wharf, are rapidly stored in the various sections of the Works prepared for their reception. Large quantities of the gums which form the foundation of varnish are imported from Africa, New Zealand, and other countries, amongst the varieties being Sierra Leone copal,—from which, by the way, the best carriage varnish is made,—Anime, Kowrie, and Manilla. These are the names of only a few, coarse and fine gums of many qualities being required for the different descriptions and shades of varnish. Anime gum is brought from Zanzibar, and used for the superior kinds of manufacture. On arrival at the factory, the gums are carefully sorted, after which they are passed through a crushing machine, and stored in boxes and bins. Every arrangement is made to economise labour, and to this end ingenious machinery is introduced wherever possible. The oil is brought to the Works in pipes, which are

emptied into a well on the canal bank. It is then taken by means of steam-pumps to adjacent tanks fixed against the exterior wall of the "Making-room," into which it is conveyed, as required, through taps contiguous to the furnaces. The quantity of oil to be drawn off for heating is first accurately measured by a special apparatus, the whole series of operations being strikingly characteristic of the time and labour-saving principles in vogue at the Works. The turpentine is received, stored, and distributed in a similarly prompt manner.

When the gum is ready for melting, it is put into large pots, which have copper bottoms and iron sides, and, by means of hand-trucks, these are carried along tramways to the furnaces. It is now that the first process in the manufacture of varnish begins. Whilst the gum is melting, the oil is being heated to the proper temperature, and at the critical moment the two are amalgamated. The operation of mixing requires great precision of judgment, and skill in handling, which can only be attained after years of patient practice. When the mixture has become perfectly bright, it is taken to the "Cooling-shed" to prepare it for being thinned to the proper consistency with turpentine. Before following the varnish further, a few facts in connexion with the department already named may prove interesting. The "Making-room" is, without doubt, the most capacious of its kind in the Kingdom. It has specially arranged flues over the furnaces, which carry off the fumes into the open air. During the course of inspection, we were shown the melting-pots used at the foundation of the Firm, and the contrast, in point of size, between them and the ones now in use, demonstrates the gigantic strides which have been made in the business, the original pots "running" from three to seven pounds of gum, whilst the modern ones are of a sufficient capacity to melt as much as five hundredweight at one time. There are four boiling and nine melting furnaces in the Making-room; whilst a series of tramways and turn-tables give facility to the operations, and connect the various departments throughout the factory.

The varnish having been cooled, and afterwards thinned by the admixture of turpentine, is conveyed in the pots by means of a crane from the "Thinning-room" to a floor over the Store-room, whence it is conducted by a series of pipes having movable branches into tanks below. It is then left to mature before being drawn off into casks for transmission to the London warehouse. The tanks hold various quantities up to two thousand gallons, and several even four thousand. When it is stated that the number of tanks is nearly three hundred, some little idea of the immense storage space may be gained. Vast as is the capacity of this long warehouse, it was found necessary to build an "annexe," which provides storage for some scores of smaller tanks having a capacity of from three hundred to five hundred gallons. The small tanks, which were sufficiently capacious for the needs of the business nearly a century ago, are still in use, but look almost ridiculously inadequate when compared with the immense cisterns to which reference has just been made. The modern tanks are made of strong boiler-plate iron, and are covered in such a manner as to guard against the intrusion of dust and reduce the danger of fire to a minimum. When the varnish has matured, and is quite ready for use, it is drawn from the tanks only to a certain depth, in order to prevent any sediment being extracted. The refuse is afterwards tapped, and again refined. Messrs. Wilkinson, Heywood, & Clark, like most large manufacturers, have, at certain times, a considerable amount of capital lying dormant, as some qualities of varnish require even a couple of years to attain maturity.

For the purpose of weighing, patent machines are employed to show either the French kilogramme or English hundredweight. As exemplifying the scope of the business, the following are some of the varieties of varnish manufactured by the Firm:—Italian varnishes for light coatings; varnishes for enamels, inside decorations, and for paper; upholsterer's furniture varnish; spirit varnishes; French polish; varnish for engines, tenders, and all work exposed to great heat; coach varnish; elastic carriage varnish; maple varnish and varnishes for japanners; knotting varnish, to conceal knots in wood; also varnishes for carved work, musical instruments, pictures, &c.

The well-furnished Laboratory is under the care of a clever young Doctor of Science of London University, whose original experiments for the practical development of the trade have gained for him the high appreciation of Messrs. Wilkinson, Heywood, & Clark and their customers. In this department, all the operations of manufacture are guided with mathematical precision, whilst, from time to time, fresh discoveries and improvements are made. In the Testing department, the varnish is subjected to every possible trial, in order to ascertain if it is up to the standard of quality for the different kinds of work and climate in which it will be required. For instance, the varnish for coaches or railway carriages is tried on wheels, panels, and bodies, when, if it does not pass a rigidly searching examination, it is promptly rejected as unmerchantable. It is well known in the trade that certain colours, such as sage greens and lakes, affect the varnish used upon them in a detrimental manner. If, therefore, it can pass muster on these pigments,

it is reckoned that it will successfully stand any trial. The Firm are accordingly scrupulously particular in testing all their varnishes on the colours named. Coloured, grained, and plain mahogany boards are also each in turn tried, so that it is almost a matter of impossibility for any article of inferior quality to leave the premises. The Test-room is kept at a certain degree of temperature, so that nothing is left undone to render the experimental details in every respect perfect. The colours, japans, &c., are likewise put through a trial in this department, and when they leave it, are fit to pass the scrutiny of the most critical judges.

The Colour-making section of the Works is the next portion worthy of notice, and its organisation is equally on a par with the high state of efficiency in the departments already visited. A plentiful supply of water is obtained for this and the other branches of the Factory by means of two artesian wells, which daily discharge an immense volume of water. The numberless ingredients for the colours are kept in convenient stores, in order that the various processes may be facilitated, and many of the hues and tints arrived at are strikingly beautiful. From the British Museum Department of Prints and Drawings Messrs. Wilkinson, Heywood, & Clark had the honour to receive a letter stating that the samples of their

"MAKING-ROOM," WEST DRAYTON.

non-poisonous colours which they had submitted had been tried in oil and distemper, and had proved, both for brilliancy and texture, far superior to any others, many English and Italian artists and art critics in the department expressing their unanimous approval of their merits. When the colours are properly finished, they are forwarded to the London establishment for immediate dispatch, or for grinding purposes.

The machinery used in connexion with the Works is driven by a couple of vertical tubular boilers of improved design, which provide a constant supply of steam. The self-contained system of the Firm is further illustrated in well-provided Carpenter's, Engineer's, and Blacksmith's shops. The majority of the employés, both at the West Drayton and London Establishments, have been with the Firm for many years, and thus all branches of the business enjoy a mutual success which ensures co-operation and good feeling between masters and men. Messrs. Wilkinson, Heywood, & Clark have several pensioners upon their bounty in the persons of aged and enfeebled workmen, for whose comfort they are always solicitous.

A visit to the London Premises, situate in Caledonian Road, N., affords further testimony of the high standard of organisation under which the operations of the Firm are conducted. This Establishment, besides serving

as a vast receiving and forwarding house, is also the seat of the Firm's large operations as Colour-grinders. The building shows a frontage of four storeys, the ground floor being occupied by the Manager's and General Offices, all commodiously arranged, and well-furnished in varnished pitch-pine. Through a broad archway on the right, the Receiving-yard is reached, which is entirely roofed with glass. Here a comprehensive glance can be taken at the extent of the premises, which form the boundaries on its four sides. In an immense Packing-room which leads into the yard, the despatch of orders is attended to by a staff of clerks and assistants. All goods have affixed to them labels printed in various languages, according to the countries for which they are destined, and by a system of numbers the likelihood of error in packing is avoided. From the Forwarding department access may be had to the Varnish-house, where some fifty tanks with a capacity of 500 to 2,000 gallons each, hold an average quantity of 80,000 gallons of Oil-varnish, and 2,000 gallons of Spirit-varnish ready for use. Between this department and the Spirit-varnish house are iron doors, and the same precaution against fire obtains throughout the premises.

The making of Spirit-varnish, which is confined to the London Works, differs essentially from the manufacture of Oil-varnish. Heat is not required to effect a union between the ingredients. In the Spirit-varnish house, one of the most interesting features is the manufacture of French Polish, for the excellence of which Messrs. Wilkinson, Heywood, & Clark enjoy a reputation beyond that of any Firm in the trade. Their orders are frequently for a thousand gallons at a time, which, when it is known that the demand for this article is more or less limited, may be taken as an exceptionally large quantity. A number of workmen are engaged in making French Polish all the year round, and the *modus operandi* may be here shortly described. There are several sets of apparatus, each consisting of a series of barrels, fixed at a slight angle. The methylated spirit and shellac forming the basis of the polish having been placed in these barrels to about three-fourths of their contents, the apparatus is made to revolve by machinery. It requires from two to three days' working in this manner to cause a complete admixture of the ingredients of the polish, which, on being removed, is in a finished state. To the manufacture and storage of various forms of Spirit-varnish three spacious floors are devoted, and in this section all kinds of wood stains are also made—such as oak, walnut, and maple.

Colour-grinding, in either oil or water, is carried on by means of heavy roller-mills driven by steam, each capable of turning out some five tons of colour per day. The waste heat serves to regulate the temperature of a large Colour drying-room. White lead is ground in very large quantities, and in the same section is to be witnessed the manufacture of a patent drier for mixing with oil paints, ground colours, and varnishes. This drier is a specialty of the Firm, and there is a large demand for it in all parts of the world. The department for ready mixed paints shows three steam-driven mixers at work, which operate upon the colours and oil by revolving knives, and bring about their thorough combination. A vast variety of brilliant and durable shades, possessing excellent drying properties, are manufactured.

The division of the premises in which the Export packing is conducted conveys an adequate idea of the extent and ramifications of the Firm's foreign business. Motley displays of goods meet the eye at every turn, and the scene is one of the most striking to be witnessed anywhere in the Works. As at West Drayton, there are elaborate "Trying-rooms" for the various descriptions of varnish and colours, in which the most severe practical tests are applied. The Laboratory is arranged for all the requirements of the business, added to which original investigations are here carried on by the Doctor of Science before mentioned.

Messrs. Wilkinson, Heywood, & Clark are contractors to the Admiralty, the War Office, the India Office, the Colonial Office, the Board of Trade, to the Indian Government, and to various Railway companies, both at home and abroad. They have been the recipients of numerous honours for the superiority of their varnishes and colours. At the Paris Exhibition of 1878 they were awarded the only Gold Medal. In 1867 they also took a Prize Medal at the Paris Exhibition. To the London Exhibition of 1862 the Firm sent a board showing specimens of their coachbuilder's varnishes, and they obtained a Prize Medal. After the lapse of a quarter of a century the varnish on the board is still fresh and lustrous, notwithstanding the rough usage and exposure to which it has been subjected in various parts of the world. At the New Orleans Centennial Exhibition, 1885, three Gold Medals were awarded to the Firm. Messrs. Wilkinson, Heywood, & Clark have branch houses in Liverpool, Bombay, and Paris, besides upwards of seventy continental depôts.

The progress of this Firm amply testifies to the value of energy, prudence, skill, and perfect honesty in all business operations. The customers, whose interests they faithfully serve, help by recommendations to enlarge their influence and prosperity, the result being that, from a comparatively humble beginning, Messrs. Wilkinson, Heywood, & Clark have established an industry which for extent, completeness, and quality of its products, stands second to none in England.

Messrs. William Woollams & Co., London.

ANY work of reference to the trades and industries of Great Britain would be incomplete without a notice of Wall-paper Manufacture. In the interest of intellectual progress, it is fortunate when a large national industry, which is based upon necessity, can be made educational and civilising in its influence; and it is still more fortunate when those in whose hands the direction of such an industry lies are fully cognisant of its possibilities, and seek in every way, often at great personal loss, to advance and further such aims.

Of such educational capabilities is the great Paper-staining industry, or, to use the name by which it is known to the public, the "Wall-paper Trade." Within the fifty years' reign of our gracious Queen few, if any, of the art industries of Great Britain have made such remarkable progress. In a lecture recently delivered by Mr. George C. Haité before the Society for the Encouragement of the Fine Arts on "Wall-papers and their Manufacture," it was pointed out that "this industry, over and above its importance as a manufacture and means of educating and increasing the national taste for art, has that glamour surrounding it which genius never fails to cast over all it touches. Its history for the last fifty years is built upon the efforts of such gifted men as the late Sir Digby Wyatt, Welby Pugin the elder, Owen Jones, and Bruce Talbert"; while its honourable position is still being maintained by the foremost of our art-workers. The names of these modern designers are as inseparably interwoven with the history of Wall-paper manufacture as are those of the great Echardt Brothers, Sherringham, and, to come to our own day, Mr. Frederic Aumonier, of whom, as representative of the Firm of Messrs. William Woollams & Co., we give a portrait, and shall have to speak at greater length anon.

To summarise part of the lecture referred to, we may say that, although there is no desire to keep secret the general processes of manufacture, the public are completely ignorant of the way in which an artist's design is converted from a drawing into a wall-paper. It is assumed to be by mechanical process, but mechanism has little to do with the production of best work. The design being finished, passes into the hands of the "putter on," who transfers it to the surface of a wooden block; the block is then handed to the "cutter," who cuts away all the parts not required, leaving the surface in relief. It then passes to the printer, who prints it, manipulating it entirely by hand, in the colours decided upon by his employer or director. In all these processes, unless each workman in turn has a large share of artistic feeling, there is a tendency to degrade the original spirit of the drawing, and it is only by careful supervision of each process in detail that the best results are attained. Space not permitting us to go more fully into the history of the trade, we must confine ourselves to giving as comprehensive a sketch of the Firm we have selected to represent this important industry as the character of this work will allow.

The Firm of Messrs. William Woollams & Co. is thoroughly representative, and, even in this age of competition, need fear no rival. They have always devoted themselves exclusively to "hand-work;" that is,

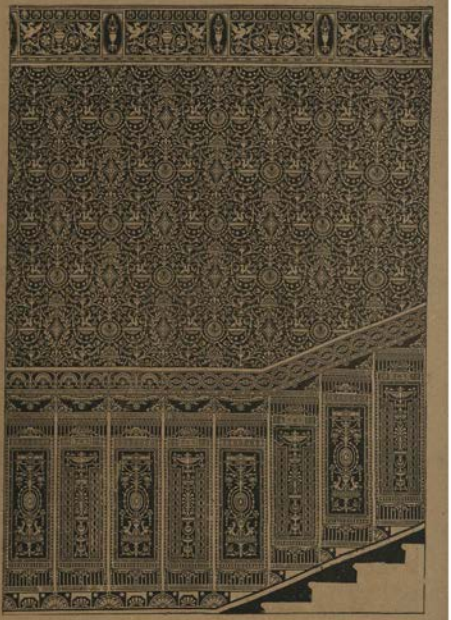
printing from wooden blocks manipulated by hand, as distinct from the more rapid method of roller printing by steam power. It is hardly necessary to point out the superiority of the former method, and the advantages of hand-work over machine goods in the greater durability and excellence of manufacture. The name of the Firm is widely known, for in every Exhibition of importance since the Great Exhibition of 1851 down to the important series but just concluded at South Kensington their patterns have been on view, and have never failed to receive substantial recognition, no less than seventeen gold, silver, and bronze medals having at various times been awarded to them. The founder of the house was Mr. William Woollams, who served his apprenticeship to Sherringham, the most renowned paper-stainer of the early part of this century. His receptive nature was imbued by Sherringham with the love for all that was good and beautiful, and with a respect for the conscientious observance of principles that were necessary for lasting success. Sherringham had a worthy successor in his pupil, who started for himself some sixty years ago, the business having been carried on at the present address, 110, High Street (near Manchester Square), London, W., during the last fifty years.

THE "TOURS," DESIGNED BY MISS LOUISA AUMONIER.

The founder of the business applied the principles inculcated by his master, producing nothing that was not, as far as he could make it, excellent of its kind; and this, too, at a time when artistic feeling was little understood or appreciated. The reputation of the Firm for good designs and excellence of manufacture was firmly established before his decease, which unfortunately occurred at a comparatively early age. He was succeeded by his three sons, William, Thomas, and Henry, the last-named inheriting by far the larger share of the artistic spirit of his father. He took a leading part in the superintendence of the business, and continued the policy of his father with such enterprise and success that the technical journals of that time—albeit often lamenting the condition of the trade generally—contain frequent reference, in terms of high praise, to the works of the Firm of William Woollams & Co.

The earliest public recognition of the merits of their productions was the award of the Silver Medal by the Society of Arts in 1848, the design for which it was awarded being a rich arabesque pilaster composed of no less than 120 blocks. In 1863 a novel experiment was tried, the Firm sending out a special set of patterns, all of Mediæval designs, by Mr. G. T. Robinson, F.R.I.B.A., upon which the *Athenæum*, *Builder*, *Art Journal*, *Building News*, and other journals of that date made the most complimentary remarks. One paragraph from the *Builder* upon this subject we cannot refrain from quoting:—"We have to *repeat* our acknowledgment to Mr. Robinson and Messrs. Woollams. Every endeavour to raise the industrial arts, and to put within reach of moderate means tasteful adornments for houses has our best wishes, and deserves our best words."

From this time forward, in consequence of the increasing feeling for art and the rapid advance of machine printing, increased energy was needed in order to maintain the position of the Firm, and recourse was had to the most skilful designers to supplement the valuable collection of patterns already in the possession of this Firm. Amongst others, the late Sir Digby Wyatt was employed to design a "Cinque-Cento" decoration for exhibition in Paris in 1867; and in the Exhibitions which followed designs have been shown by Miss Louisa Aumonier, Messrs. Owen W. Davis, A. F. Brophy, George C. Haité, O. K. Rickatson, A. Silver, A. E. Sedding, E. Wildey, J. West, C. F. A. Voysey, J. Lessels, T. W. Hay, and others. These designers work in many styles, and each may be said to possess distinct individuality; did space permit it would be an agreeable task to give an analysis of their chief works, but as that is not possible, we must be content to refer briefly to those whose designs have been selected for illustration.



THE "GROSVENOR," DESIGNED BY OWEN W. DAVIS.

Place aux dames! Miss Aumonier has heartily identified herself with her brother in the reproduction, as wall-papers, of many beautiful old designs originally used for silks and velvets; and the experience gained from such adaptation of old work to modern requirements has given her great power in the composition of her original patterns, especially those of early Italian, Venetian, or Genoese style, such as the "Tours," which we illustrate. In these styles she has made a path all her own. Mr. Owen W. Davis could hardly be better represented than by his "Adam's" decoration (the "Grosvenor"; *see* our second illustration), with which style he has identified himself. Our third illustration, the "Agra," is a decoration designed by Mr. George C. Haité, which has been highly commended by the trade journals.

In 1876, owing to the sad loss the Firm sustained by the death of Mr. Henry Woollams, his cousin, Mr. Frederic Aumonier, who had been his active assistant since 1853, took the lead, and became at once proprietor and director. The history of the Firm would indeed be incomplete if we were to neglect, or too briefly pass over, the influence exercised and the active part taken by Mr. F. Aumonier, under whose judicious direction the progress of the Firm might be described as phenomenal. It was his good fortune to spend twenty-three years under the guidance of his kinsman, and being possessed of exceptional abilities and artistic tastes, he found the work congenial, giving him opportunities of exercising both his natural taste and business capacities. He was soon in thorough sympathy with all the traditions of the industry, taking an absorbing interest in all its varied details, and sparing no pains or trouble to maintain and advance the high reputation of the Firm. The taste Mr. Aumonier displayed in the selection, execution, and colouring of his patterns, evincing artistic appreciation of no common kind, is doubtless, to a great extent, hereditary. His brother, Mr. James Aumonier, R.I., ranks as one of our foremost landscape painters. Another

brother, Mr. William Aumonier, is, in his own branch of art, Wood-carving, a leader known for excellence of workmanship and artistic feeling; while of Miss Louisa Aumonier's ability as a designer we have already spoken.

The name of William Woollams, coupled with that of Frederic Aumonier, will always be gratefully associated in the public mind with the abolition of the use of arsenical colours. When the agitation against the employment of arsenic in wall-papers first arose, Mr. Aumonier, to the manifest advantage of the public health took an active part in the introduction of non-arsenical papers. "To the Firm of Messrs. William Woollams is due the lasting honour of being the first to discontinue using the pernicious drug. This occurred in or about the year 1858, when they finally decided to abolish it from their factory."

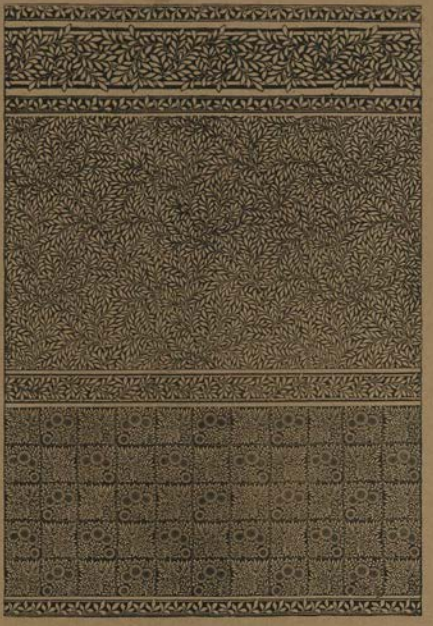
This was not only a generous and public-spirited action, but a very expensive one, for it was soon found necessary to destroy all the sieves, brushes, and the various paraphernalia, and procure much new plant. It was

MR. FREDERIC AUMONIER.

discovered that particles of the mineral had impregnated everything in use, and although such small quantities would be harmless, there was really no other means of totally excluding arsenic from the manufactured goods in order to keep absolute faith with the public. As characteristic of his earnestness in the matter, and the better to achieve his aim, Mr. Aumonier made himself acquainted with various scientific methods for the detection of arsenic in wall-papers; and he was one of the experts selected by the Society of Arts to form a committee appointed by that body, to consider the practicability of preventing by enactment the employment of poisonous colours.

Amongst the improvements and novelties introduced into the English trade by Mr. Aumonier was the "stamped gold" process in 1864; two years later that of "embossed leather paper," and in 1878 he patented his invention for modelling the surface of raised flock paper. Perhaps in none of the various kinds of wall-paper made by Messrs. William Woollams & Co., has so marked a progress been made as in the manufacture of flock papers. The old-fashioned flock, or *velouté*, was simply an imitation of velvet, but flock is now used in a variety of ways. Raised flocks for painting over are now a very important industry in

themselves, and are extremely useful for the ready decoration *in relief* of ceilings, dados, and other flat surfaces. Mr. Aumonier's patent embossed flock papers are a further development of the same idea, the raised surface of the flock being beautifully modelled by pressure with a heated die, producing an effect like carving. Following up the combinations of flock with other materials, raised flocks upon mica grounds have recently been introduced,



THE "AGRA," DESIGNED BY GEO. C. HAITÉ.

and a fine display of them was shown at the recent Architectural and Building Exhibition at the Agricultural Hall. It would be difficult to estimate the benefits derived by the public from the sustained efforts and industrial careers of such men as Mr. Aumonier, and we cannot but feel, that in giving a summary, no matter how brief, of the qualities which have been devoted to the founding and growth of a business such as his, we are encouraging many who have yet to achieve success.

The Dublin Whisky Distillery Company, Limited, Dublin.

THE Imperial Exchequer draws a larger revenue from whisky distilling than from any other source of commerce. In Ireland the annual "output" amounts to nearly twelve million gallons of whisky annually. That, therefore, whisky forms one of our leading industries cannot be doubted. It has been computed that nearly one million and a half of Her Majesty's subjects derive their subsistence from this industry. It is not our intention to write a scientific essay on whisky distilling; what we will endeavour to set out will be more a short "history of the trade" and its rapid development.

It is a curious fact that almost fifty years ago (early in the year 1838) Morewood, an excise officer at Dublin, published an interesting pamphlet, entitled "Inebriating Liquors," and this has ever since formed a work of reference on the subject of whisky and whisky distillation. The early history of the art of distillation is buried in obscurity. It is only some fifty or sixty years ago that whisky distilling became anything like a "home industry." At about the year 1825 the Earl of Ripon, then Chancellor of the Exchequer, really laid the first foundation to what has since proved such a gigantic aid to our Exchequer. From 1825 to 1858 various alterations and improvements were made in the taxation of this industry. In the latter year the late Lord Beaconsfield (then Mr. Disraeli) established a uniform rate of duty of 8s. per gallon. Mr. Gladstone raised this to 10s. per gallon in 1860, at which rate it has remained ever since.

That at the present moment the whisky consumption is higher than ever it was before is proved most conclusively by statistics. French brandy has suffered in public favour owing to the inferior qualities sent to this country; the phylloxera and other diseases of the vine destroying the material for "good" brandies. Gin is fast dying out, except as a medicinal spirit. The medical profession, moreover, have of late years advocated the pure whisky as an agreeable and wholesome aid to curing the various maladies arising from over-diet, and resulting in gout, dyspepsia, indigestion, and other kindred complaints.

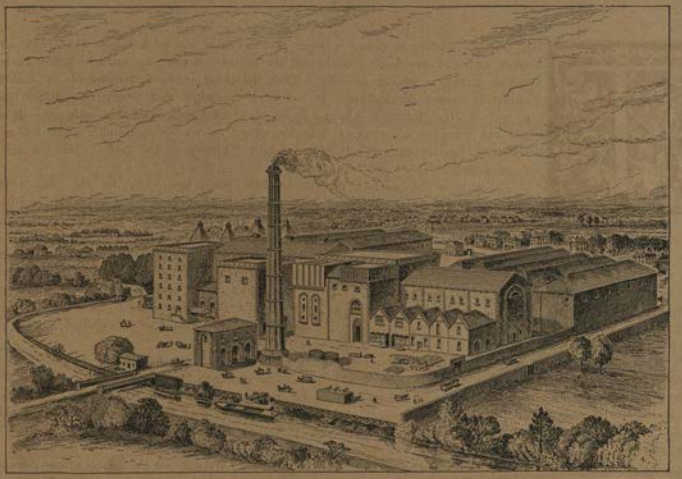
There are about thirty large and well-known distilleries of whisky in Ireland, but the space at our disposal will not permit us to mention more than the one Firm whose name is associated with this article. The Jones Road Distillery is situated in one of the picturesque suburbs of Dublin. The distillery itself is one of the most modern in Dublin, but the ground on which it is built, as well as its immediate surroundings, are full of historic interest. Although the River Tolka flows actually through the grounds of the distillery, its water is mainly used for driving-power, the water for distilling purposes being brought through pipes from the Royal Canal. The distillery buildings are most imposing, constructed of red brick about 65 feet high. The chimney, a handsome ornamental structure, about 140 feet high, is also built of red brick. The internal arrangements are carried out on the most modern and approved principles. The "plunger pump," built by Messrs. Pearn & Co., of Manchester, is one of the finest specimens of hydraulic machinery; it is capable of raising

some 1,000 gallons of water a minute. Another remarkable feature in this distillery is a "Leffel Turbine Wheel" fixed in the middle of the stream of the River Tolka, with a water-power equal to 50 horse-power. This wheel is the only one in use in any distillery in Ireland.

The large maltings of this distillery are situated in Russell Place and Cork Street, in close vicinity to the Midland Railway Depôt. The offices, sampling rooms, clerks' and excise offices, and as well as the cooperage stables, cart-sheds, smith's and carpenter's shops, are highly effective structures, built on the most approved plans, and form a stately pile of well-arranged, convenient buildings. A very large number of hands are employed in this distillery. The Company, we are informed, are about to erect large duty-paid warehouses on an adjoining estate lately purchased by them. Messrs. George John Alexander, Matthew H. Chamberlain, James Costello, William H. Maturin, and O. T. Allingham are the present directors of the Company.

THE POT STILL.

The business of the Dublin Whisky Distillery Company extends all over the world. Their present output is nearly 600,000 gallons annually, and their trade in England, India, and the Colonies is daily increasing. The illustration herewith is the well-known trade-mark of the Company.


JONES ROAD DISTILLERY.

This Company is in every way worthy to rank as one of our leading distilleries for Irish whisky, and by comparison of the qualities of their distillations with those of older and larger Firms, it will be found that nothing remains to be desired in the perfection in which the D W D whisky is placed before the consumers. Their London Agents are the well-known and highly-esteemed Firm of Messrs. Butcher & Robinson, 11, Great Tower Street, City.

Messrs. T. W. Beach & Sons, Limited.

Lord Sudeley's Fruit Farm, Toddington, near Winchcomb, & at Brentford.

REGRETTABLE as the fact may be, it can scarcely be denied that, along with extraordinary development in scores of useful arts and industries, the present reign has witnessed also a marvellous development in the art of adulteration; and we therefore take special pleasure in recording honest attempts on the part of manufacturers to compete with unscrupulous rivals, and yet not resort to an art so liable to be attended with baneful effects. Unfortunately, in the case of ordinary jam it is remarkably easy to introduce without detection various substances in addition to those of which the article professes to be made; and when the concoction is sold to the public, as it so frequently is, in opaque earthenware jars, there is not even a chance for the purchaser to detect adulteration, at all events until after the purchase is effected. Some years ago it occurred to Mr. T. W. Beach,—who from the very first has adhered strictly to the principle of introducing into his jams no foreign matter whatsoever,—that were he to manufacture whole-fruit jam and sell it in glass bottles, the public would be better able to judge for themselves of its purity, and, at the same time, would obtain an article from which the flavour of the fruit had not been stewed away. Accordingly, he adopted the system of manufacture for which he has now become famous, and began, in consequence, to reap the reward of his honesty. In addition to his leaving the fruit unbroken and employing glass jars, another specialty about his system is the manner in which the stalks are removed from the fruit. The general practice is to use an automatic machine for the purpose; but in order to avoid any danger of the fruit being crushed, Mr. Beach has all the stalks carefully picked off by hand, notwithstanding the extra trouble and expense of the process. For several years his only establishment was at Ealing Road Gardens, Brentford; and here, in conjunction with his sons, by adhering to the principles he had laid down, he gradually built up from small beginnings a very considerable trade. Messrs. T. W. Beach & Sons had the advantage, we believe, of being the first manufacturers to introduce the whole-fruit system; but the absolute purity of their jams was unquestionably the foundation of their prosperity. We much doubt whether any other makers in the country can truthfully boast that they have never employed any substance but fruit and sugar, not even glucose, in the manufacture of their jams.

Meanwhile it so happened that Lord Sudeley, whose estates are situated in Gloucestershire, had been casting about for some means of increasing the returns from his property, and had hit upon the expedient of starting a fruit farm. In the winter of 1880 he commenced the planting of fruit trees at Toddington, and soon had a large acreage devoted to this branch of agriculture. In the course of a year or two, however, he came to the conclusion that to make a fruit farm pay it was absolutely necessary to have some means of preserving a large proportion of the fruit on the spot: not only might a great economy thus be effected in a variety of ways, but the fruit would be saved from the injurious effects of travelling long distances, exposed to sun and rain, before being utilised. Feeling sure that to undertake the manufacture of jam himself would be a

risky proceeding, Lord Sudeley, in 1882, began to look out for some established manufacturer, whom he might induce to start a branch business in the midst of the Toddington plantations; and eventually he came to a satisfactory arrangement with Messrs. T. W. Beach & Sons. Lord Sudeley, on his part, agreed to convert certain large buildings on the farm into a factory, and to afford every convenience for the making of jam; while Messrs. Beach agreed that they would gradually make this the main branch of their business, and would take the great bulk of the fruit grown on the farm, which by this time was 500 acres in extent, for a term of years. In due course the factory was started, and since the commencement of work very rapid progress has been made.

The fruit farm of Lord Sudeley, portions of which were in former times devoted to the cultivation of tobacco, lies in a district long celebrated for its fruit, and in many respects is peculiarly well situated for the manufacture of jam on a large scale. An immense amount of labour, however, has been necessary in order to convert the 500 acres of arable land into a first-class fruit farm; nor have knowledge and judgment been less requisite in selecting the different varieties of fruit to grow. The plums and damsons and other tree fruits are planted at a distance of fifteen feet apart, with bush fruits five feet apart between them, and

LORD SUDELEY'S FRUIT FARM AND MESSRS. BEACH'S JAM FACTORY.

in many cases with strawberries between the bush fruits. Upwards of 80,000 damson and plum trees have been planted, in addition to large numbers of apple, cherry, and pear trees of choice varieties, both standard and pyramid. The bush fruits comprise black and red currants, gooseberries, and raspberries, and also cob nuts. About 180 acres are planted with strawberries, a large proportion of the plants being of the celebrated American scarlet variety, to which in a considerable degree are due the splendid colour and flavour of Messrs. T. W. Beach & Sons' jams. When the picking season arrives, large numbers of women come down from the populous districts towards Birmingham, and reside in sheds specially fitted up for their accommodation at one end of the plantations. A hundred and fifty or so live here for a couple of months in the fruit season, while women and children to the number of five or six hundred flock in for the day from the surrounding parts to help in the work; but no men are allowed in the plantations at this time. When gathered, the fruit is carefully sorted, and passing, while the bloom still remains upon it, into the boiling-room, is there converted into jam in copper pans heated by steam. As soon as cool, the jam is taken to the large bottling department, there to be put up in the glass bottles in which its rich colour, and in some degree its magnificent quality, may be perceived by the eye of the purchaser. We should mention that in addition to jams of all kinds, various other products are turned out at the factory, including jellies, bottled fruits,

and evaporated apples: the bottled fruit department is a new and important development of the business. Another product also is the sugar-preserved fruits, made with the greatest care in the French style by French cooks.

Taking now another glance round the farm, we find many things of interest besides the fruit trees themselves. On the advice of Sir Joseph Hooker, Lord Sudeley has established a large apiary, the largest in fact in England, comprising no less than 250 hives; and no doubt can be entertained that the bees materially help to fertilise the fruit. The honey is sold to the public either in sections or bottled, and being made from the blossom of the fruit trees is of delicious flavour. Italian queen bees are successfully reared in the apiary for the market. Between the fruit trees large and increasing quantities of flowers are grown, which are sent up from the farm to Covent Garden Market. Tomatoes also are raised in great quantities; nor must we forget the osier beds, which enable all the baskets used to be made on the place; nor the nursery, which supplies the neighbouring districts as well as the farm itself with young fruit trees of every variety. Since their installation at Toddington, Messrs. T. W. Beach & Sons' business has considerably more than doubled; they have now formed themselves into a small Company, in which Lord Sudeley is a large shareholder. As time passes, the

INTERIOR OF JAM FACTORY.

amount of fruit available for jam-making, already very large, will become enormously greater; but, considering the advantages possessed by the Toddington system of manufacture, there need be little fear that the supply of these jams will exceed the demand. Messrs. T. W. Beach & Sons, by the way, obtained a Gold Medal for their whole-fruit jam at the Health Exhibition against all competitors, and have altogether received four Gold and four Silver Medals for the purity and excellence of their goods.

In concluding this article we ought to mention that, while not wishing to discourage the farming community from imitating Lord Sudeley's experiment, we should be sorry to underrate the various difficulties which have to be overcome in order to render it successful. A choice situation is absolutely necessary to begin with, where the soil and the climate are both suitable and markets can easily be reached, in all of which respects Lord Sudeley's estates are peculiarly favoured. A large capital, too, is required for the experiment; nor is it always possible to find a manufacturer of good repute ready to start a branch business on one's property. As a matter of fact, Lord Sudeley has experienced considerable difficulties in making his venture a financial success, although fortunately these are now disappearing.

The Willesden Paper and Canvas Company, London.

IN the year 1868 Dr. John Scoffern was granted the first of the series of patents that have since enabled him to develop one of the most useful of modern substances. A Company was formed in 1873 to work his invention, which has been subsequently amplified and perfected by other improvements. This process has, since its practical establishment, created a large amount of attention, not only in the industrial but in the scientific world; and it may be useful here to give a few words of explanation regarding its remarkable properties and the results it accomplishes.

By impregnating paper, canvas, and other vegetable fabrics, with a solution of copper and ammonia, an extraordinary change is effected in their nature, enabling them to be used for purposes which, in their normal condition, these materials are totally inadequate to fulfil. Paper, after treatment by the Willesden process, is scarcely altered in its exterior appearance; but it has acquired, all the same, a most remarkable property of withstanding all the agencies which ordinarily contribute to its injury and decay. The Willesden paper, which is used for an unending multiplicity of purposes, is totally impervious to the influence of the weather, and, indeed, nearly indestructible. In the form of roofing it is, without doubt, the best and most convenient material for that purpose, whether at home or abroad. The "roofing" has attained a very considerable degree of celebrity, its unqualified merits having earned for it the attention of Governments, public bodies, and merchants all over the globe. A few instances of its adoption on a large scale may serve to show the repute in which it is held; and we may say that, despite the very trying circumstances under which, in many instances, it has been obliged to compete with metal, the Willesden paper has always achieved a complete success. The roofing, &c., was used at the following Exhibitions,—"Fisheries," "Health," Bristol, Amsterdam, Liverpool, and Newcastle. It is in use on a very extensive scale in Egypt, the National Aid Society's huts at Assouan and Korosko being entirely constructed of Willesden roofing; the Port Said British Hospital is roofed with it; and it has been extensively used on the Suakim-Berber Railway, &c. This roofing is at once light, durable, and impervious to the ravages of the white ants and other insects that occasion so much damage in tropical countries. The qualities of the Willesden paper may be summed up in the following:—light, durable, rot-proof, damp-proof, water-proof, convenient for use and inexpensive; and that the claims made for the excellence of this material are well founded is proved by the substantial evidence of seven Gold and eight Silver Medals, besides Honourable Mentions and other certificates of industrial merit.

But perhaps the largest and most brilliant example of the use of this material to be seen in this country will be found at the Newcastle Jubilee Exhibition this year. The London Depôt of the Company was fortunate enough to be entrusted with the contract to reproduce a facsimile of the old Tyne Bridge. After painstaking research in the British Museum and amongst local antiquaries, the maximum of archæological correctness has

been attained, and the bridge, with its quaint houses and shops, immediately attracts the attention of the visitor to the Exhibition.

The Bucknall Patent Portable Hospital also exemplifies in a remarkable manner the adaptability and usefulness of Willesden manufactures, Mr. Bucknall making use both of canvas and paper for the outsides and interiors of his permanent and portable hospitals and other buildings. The discovery of Willesden materials was the cause of his turning his attention to the supplying of a great modern want, viz., the provision of a perfectly portable building ready furnished, capable of erection without skilled labour, at once healthy and comfortable. For epidemic hospitals, for schools, villages or large cities, as a military field hospital, or for colonial or emigration uses, this invention bids fair—solely and entirely from the excellence and applicability of Willesden materials—to take a most important position amongst the aids to the health and comfort of our working populations.

The canvas treated by the process acquires properties of no lesser value than the paper. The material becomes absolutely rot-proof, and this without impairing its appearance or flexibility in the smallest degree. We need hardly say, in view of these facts, that this fabric, so treated, enjoys an immense and still increasing popularity among people of maritime pursuits. All the productions of the Company are promptly supplied by the London Depôt, at 34, Cannon Street; and from thence, by energy and enterprise, they have been widely introduced to all quarters of the globe. Among other fresh utilisations of the Willesden process, the Depôt has lately adopted one that appears likely to lead to an enormous business, viz., the waterproofing of all kinds of linen and cotton textiles for domestic use. As we have already said, the action of the process is beneficial, rather than otherwise, to the appearance of the cloth. It renders the material treated almost imperishable. Seeing this, a wide avenue is apparent leading to vast fields of new employment. The Depôt has already begun by treating cloth intended for hangings, curtains, garments, umbrellas, &c., and the additional value thereby imparted to the fabric is attracting the notice of manufacturers to a large section of English trade hitherto untouched by its application.

The Willesden process, we may mention, although working at present only in England, is patented in all countries, and, judging from its present rapid progress, may be expected, within a comparatively short space of time, to grow into a very large and important industry, abroad as well as at home.

Messrs. Hedges & Butler, London.

EVER since the year 1667, when the Firm whose name appears above was first established, the business which they conduct as wine merchants has been handed down from generation to generation in the same family; and the position, therefore, which they hold in the wine trade is one to which they are entitled by virtue of antiquity, as well as of distinguished patronage and success in business. But concerning the Firm itself we shall have more to say presently.

From the very earliest periods of history, the manufacture of wine has been carried on in every country where grapes could be grown out of doors; and its praises have been sung, as every one knows, by poets and poetasters almost without number. Among those who have attributed their length of days or their sustained activity, in whole or in part, to the moderate use of this beverage, we may mention Talleyrand and Cardinal de Salis, the latter of whom died at the age of 125; but we should not care to say how far the opinion of the modern medical school would bear out the idea that wine-drinking was conducive to longevity. From very ancient figures of wine-presses that have been preserved, it would seem that great innovations have not been made until quite recently in the process of crushing the grape; but the old system of treading the fruit still remains. The number of different varieties of vine that are grown is legion; and as each kind of vine may yield many sorts of wine, according to the circumstances under which it is cultivated, the number of wines that are, or might be, produced, is almost limitless, but the number of those that have any commercial importance in this country is comparatively small. The English, it appears, are not as a nation a great wine-consuming people, although among the well-to-do classes a large quantity of the better and more costly wines is consumed, the depression in trade notwithstanding. Chief among the wine-producing countries of Europe are Germany, Austria, Italy, France, and especially Spain and Portugal. Germany produces fine white wines, but not many red ones. The former are in considerable demand in the British market, where they are principally known as Hocks and Moselles. Austrian wines as a rule are not very largely used in this country; but the famous Tokay, which is made in Hungary, fetches a higher price when it is dealt in at all in England than any other wine whatever. A very extensive acreage is occupied by vineyards in Italy; but not much wine is exported from that country, which is rather behind other parts of Europe in the production of the better qualities. Since the commercial treaty of 1860 between England and France, great quantities of French wines have found their way across the Channel. But the wines that are best known in the United Kingdom are the sherries of Spain, the ports of Portugal, and champagne. In 1877, as many as 7,000,000 gallons of port were shipped from the Peninsula, principally from Oporto, the greater part of which came to England, where the consumption of port has been steadily increasing for nearly two hundred years. From 1866 to 1876, the average shipments of sherry from Spain amounted to nearly 8,000,000 gallons a year, and of this quantity also a great proportion came to England.

In his "Chemistry of Wine," Professor Mulder goes into very interesting particulars concerning the ingredients which are to be found in the juice of the grape; and few people would have supposed that such a conglomeration of substances was present in the juice from which their wine is made. Water is the principal component; but held in solution in the water are substances of the most diverse natures, including sugar, gelatine, gum, fat, wax, vegetable albumen, vegetable gluten, tartaric acid, potash, and lime, and in some cases, it is probable, several other kinds of acid also, besides oxide of manganese, oxide of iron, sulphate of potash, common salt, phosphate of lime, magnesia, and other substances. Most of these ingredients are to be found also in wine itself, although in some instances in different forms. According to the same authority, Professor Mulder, the proportion of alcohol in wine varies from eight or ten per cent. in Moselle to about twenty-two or twenty-three per cent. in port.

It would be out of place to give here any description of the methods adopted in wine-making, seeing that neither the growth of the grape nor the manufacture of wine is a British industry. But apart from the cultivation of the grape and the actual preparation of the juice, there is an important part for the wine-merchant

TASTING CELLAR IN REGENT STREET.

to take before the manufactured article is fit for presentation to the public. From the moment the wine passes into his possession, whether it be port at Oporto, or sherry at Jerez de la Frontera, or champagne at Rheims, to the time when it is delivered to the customer at home in England, the utmost care has constantly to be taken if the costly beverage is to give satisfaction to the connoisseur. Different wines, as is well known, attain perfection at very different ages; the temperature of the atmosphere in which the casks or bottles are kept is a matter of the first importance; various diseases have to be guarded against; and for certain wines a trip round the world is highly beneficial. So that a great amount of knowledge on the one hand, and extensive cellarage on the other, are among the necessaries for successfully carrying on the wine trade. Such a Firm as that of Messrs. Hedges & Butler, who date their existence from the seventeenth century, can hardly be deficient in traditional knowledge of their business, for the accumulated experience of generations is at their service. In regard to cellarage, too, this Firm have abundant facilities for properly handling and treating their wines; and, indeed, the extent of cellarage which they possess in Regent Street is little suspected by many of those who pass their premises in that magnificent thoroughfare day after day. Their vaults, which extend from Regent

HEDGES & BUTLER'S
WINE CELLARS
LONDON & BRIGHTON.
ESTABLISHMENT IN SPAIN
BINS OF 10,000 BOTTLES EACH.
TASTING CORNER.
ENTRANCE TO CELLARS
CELLARS UNDER REGENT STREET COVERING NEARLY TWO ACRES

Street to Savile Row, and from New Burlington Street to Heddon Street, comprise an area of nearly two acres. At their Brighton branch also, situated in King's Road, Brighton, which was established more than thirty years ago, their cellars are very large, and extend beneath the King's Road to the beach; the long cellars and vaults, which are arranged in three tiers, together with the stables, cover an area of more than an acre. The Brighton premises occupy one of the best positions in the King's Road. At Jerez de la Frontera, also, in Spain, the Firm have stores for sherry (or a "bodega," to use the correct term), where the wine is stored in order to develop before being shipped to England, or started off on its trip to the East Indies or round the world. The proud title of East India sherry is much coveted by wine-merchants for their sherries, on account of the fine flavour which can be imparted only by a voyage to a warmer climate. The butts at Jerez are four tiers high, and consist of choice old Amontillados, Olorosos, Manzanillas (said to be the purest of all sherries), Montillas, and other wines.

Messrs. Hedges & Butler's extensive and well-arranged cellars are kept at the right temperature by means of lighted gas jets, and are scrupulously clean, fresh, and wholesome. It was not always the custom of wine-merchants to keep their cellars in this clean and healthy state; for the fungus which sometimes forms as the wine develops was believed to indicate superior quality in the wine, and was therefore highly prized. But a change for the better has taken place in the customs of the trade, and specimens of this fungus are not often seen in the present day. There are various diseases, however, to which wine is subject, and the task of guarding against them, and of properly looking after the wine, is a far easier matter in large and well-planned cellars, like those under notice, than in small or awkwardly-arranged ones. The principal diseases which have to be feared are those known as the turning of the wine, the ropiness, the bitterness, the acidifying, and the mouldiness of the wine. Very little is known as to the cause of this last-named disease and the conditions under which it is produced, except that the admission of air is conducive to its development.

It was in the year 1667, as we have said, the year following that in which the Fire of London occurred, that the Firm of Hedges & Butler was established. The business was originally, and for ages after its establishment, conducted in Hungerford Street, on the site where now stands the Charing Cross Station of the South-Eastern Railway. In those days, when neither this gigantic station nor any railway or locomotive, nor even steam-engine of any kind, was dreamed of, it was important that the business premises should be near the river where the wines were landed. On the demolition of Hungerford Street, some sixty or more years ago, for the erection of the New Hungerford Market, the business was removed to Regent Street, where larger premises, which have since been still further extended, were secured. In the counting-house may be seen old ledgers dating back two centuries, and containing the names of most of the illustrious houses in the kingdom. Two old oak chairs and a table may also be seen, made from the oak posts that supported the house in Hungerford Street; the timber of which they are composed was probably cut not less than 250 years ago, or during the reign of Charles I. Many other curious and valuable archives of the business have been preserved, such as leases, bills, and other documents, and especially an acceptance given by the Earl of Holderness (whose peerage has long since become extinct) in the year 1742. This ancient and interesting bill was kindly returned to Messrs. Hedges & Butler by Messrs. Drummond, the bankers.

In proof of the success with which this historic wine business has been attended, the Firm are able to point to the warrants of appointment which they hold from George III., William IV., and Queen Victoria, the last-mentioned dated 1837; also to one from the Prince of Wales, dated 1863, the year in which he set up his own establishment. They are agents for the brand of Melnotte et Fils, which they specially reserve in large quantities for the Queen, the Prince of Wales, and the Duke of Edinburgh; for the principal London hotels, including the Grand, the Métropole, the Langham, the Bristol, &c.; for the Jockey Club; and for the principal regimental messes. This celebrated champagne is only of one quality, and is only shipped in fine vintages, such as 1874, 1878, 1880, and 1884. It has now a large and increasing sale in Australia.

Messrs. Bullivant & Co., London.

THE word Bullivant is, to any user of rope, synonymous with "Wire Rope," and we believe that there is no other Firm of whom it can be said that they have struck out in an entirely new line, and that their inventions have been nearly universally adopted. The flexible Steel-wire Rope Appliances, and the Torpedo Nets invented and introduced by Messrs. Bullivant & Co., are used by the British Admiralty, and by nearly every nation in the world which owns a navy. We shall give a short description of their extensive Works at Millwall. These are situated on the river Thames, to which they have a frontage of about 310 feet, and cover a space of about 3½ acres, and the whole of this is covered with shops, leaving only a roadway up the centre to the wharf.

The large Wire-rope machinery shop is about 250 feet long by 103 feet wide. This shop is capable of producing 600 tons of wire-rope a month. By reference to the plan on next page the general arrangement of the Works may be followed. It will be seen that the galvanising shop is adjacent to the river, this shop is 120 feet long by 60 feet wide, and it contains four large galvanising baths.

The shops on the right-hand side of the roadway on entering the Works, are all about 100 feet long by 50 feet wide, and there are six of these shops. On entering the Works, and taking the contents and the use of these fine, high, and light shops separately :—

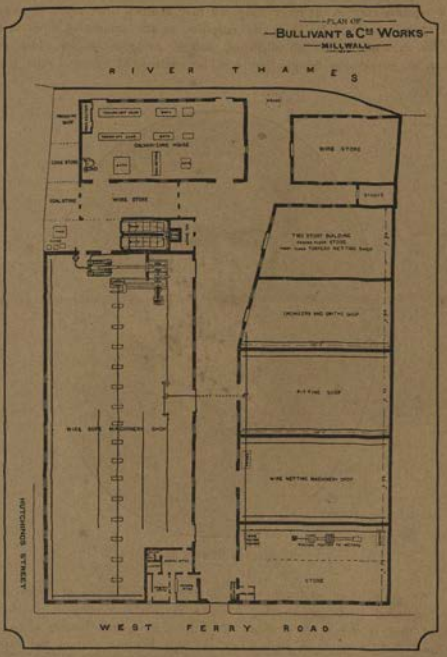
No. 1 is used principally for a testing shop, and all material used in the manufactory is tested here. There are a number of wire-testing machines, and also machines for testing the elongation, torsion, and the ductility of wire. But the principal machine is a 100-ton direct-acting lever hydraulic testing machine, which is worked for strain up to 50 tons by hydraulic pumps, and above that strain to 100 tons by a gas-engine. The machine is of the most modern construction, and was specially designed for Messrs. Bullivant & Co. by Mr. Carrington, M.I.C.E. For such a heavy machine, its delicacy and accuracy are wonderful. When it was at zero we proved this by pulling on the attachment, and we found that the force with which we were pulling was registered on the machine. A machine testing to 100 tons is ample for any practical purposes as far as ropes are concerned, because, although ropes are made to a very much higher breaking-strain, the separate parts can be tested if the rope is required to take a higher strain; thus, if a rope had to take a breaking-strain of 600 tons, each strand could be tested separately to 100 tons; but not only are ropes so tested when made up, but before the manufacture begins the wire is always tested separately, to ensure uniformity.

Shop No. 2 is used for making Wire-netting; it contains ample and complete machinery for this class of work, and produces from eighty to one hundred miles of netting a week; the netting being used for many purposes—as sheep and poultry netting, and also the smaller meshes for aviary and other purposes.

Shop No. 3 is used as a fitting shop for Wire-rope. By fittings is meant the attachments and other arrangements used for working rope—such as splicing thimbles, fitting shoes, and the other attachments generally

in use. It is also used for a rigging shop, where rigging is fitted complete, ready for putting over the mast-heads of vessels.

Shop No. 4 is the engineers' and smiths' shop. Here are made the special attachments, of which so many have been designed and invented by Messrs. Bullivant & Co., for working ropes, such as their Patent Automatic Nippers, their Patent Portable Nippers, and also their Reels for coiling and working ropes. All the incidental



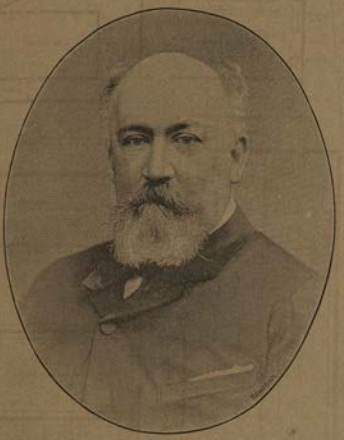
repairs to machinery, which are always necessary in some way or the other, are done here, and also the construction of new machines for their work.

Shop No. 5 (which is a two-storeyed building), the ground-floor is used for a store, and the upper floor for the manufacture of their Patent Torpedo-nets. When we visited the Works between 200 and 300 men and boys were employed on this work, producing about 200 complete nets a week. The efficiency of this important invention has been amply demonstrated by the experiments against H.M.S. *Resistance*, when it was shown most conclusively, that if a ship were protected by Bullivant's netting it was absolutely impossible for a torpedo to get near her, because the action of the torpedo is either to strike the netting and explode, in which case no injury is done to the ship or to the netting, or else for the nose of the torpedo to be caught in the

netting, in which case the torpedo simply expends its energy and falls to the bottom. These nets are now adopted on every vessel in the Royal Navy, and they are also being rapidly supplied to nearly all the navies in the world.

This Firm has not only invented this important defence, but they have also a most efficient and convenient method for working it. This we need not enter into fully here, as it is a subject of technical rather than of general interest. The shop on the wharf is used as a store.

Referring to the manufacture in the large shop, we may mention that ropes of every description are made here, from the small sash-lines used for domestic purposes, to the enormous ropes used in conjunction with hydraulic machinery for drawing vessels up slipways, and for bridge-work, for which purpose steel ropes are especially advantageous, as suspension bridges can now be constructed of steel rope, where, previously, it was



MR. WILLIAM MUNYON BULLIVANT.

impossible, owing to the weight of material, to erect them. The make of ropes depends on the purpose for which they are required to be used—thus, a rope for ships' rigging is required to be made rigid, because it is important that it should not stretch. Rope for mining and hauling purposes, for cable tramways, overhead tramways, and similar purposes, require to be fairly flexible, and, at the same time, the individual wires must not be so small as to wear through quickly by friction. Ropes for ships' hawsers, cargo falls, lifts, crane, and similar purposes, are required to be very flexible, and we need hardly say this shop contains machinery for making every description of rope that is in use. We were much struck with the gigantic size of some of the machines. There is one machine measuring 180 feet long, and there is another machine capable of throwing off 30 tons of rope in one length. This machine will make ropes up to 21 inches in circumference, and such a rope would take the enormous strain of 1,200 tons on a single part. The number of wires in a rope varies from twelve up to 720.

As might be expected, the number of awards at the principal International Exhibitions given to this Firm has been very great. Giving a few during the present decade, Messrs. Bullivant & Co. were awarded the only Gold Medal at Berlin in 1880; the highest award at Tynemouth, 1882; the only Gold Medal for Metal Ropes at

the Fisheries Exhibition in 1883; Grand Diploma of Honour and Gold Medal at Antwerp in 1885; and the only Gold Medal for Wire Ropes at the Liverpool Exhibition in 1886.

To any one acquainted with the use and advantages of steel-wire rope it is undoubtedly certain that it will entirely take the place of hemp-rope and chain for nearly every purpose. During the last fourteen years it has largely done so for such purposes as crane-work, ships' hawsers, running rigging, &c.; it is also largely coming into use for fishing ropes, not only for trawl-warps, but also for main fishing-ropes in herring and salmon fishing, and other similar purposes.

The Thames Conservancy and nearly all salvage companies have adopted steel-rope for raising sunken vessels, working it in conjunction with Messrs. Bullivant's Patent Nipper. Steel-rope is only one-third the weight of hemp-rope of similar strength, and its durability is at least three times that of hemp, and it is only one-eighth the weight of chain of similar strength, and it is far cheaper in the first cost than either hemp or chain. There is but very little question that in the course of a few years it will have entirely superseded them for many purposes for which they are now used, and for which steel-rope is just beginning (through the energy and perseverance of Messrs. Bullivant) to be employed.

Messrs. Strachan & Co., Stroud.

THE history of the origin and progress of the woollen manufacture in England is both curious and interesting, and will well repay investigation. When Cæsar invaded this island he found the inhabitants of the southern portion acquainted with the spinning and weaving of both flax and wool. Century after century has this knowledge been utilised with varying degrees of success. The woollen industry has played a not unimportant part in the history of our country. In the reign of Henry VIII., John of Winchcombe, better known as Jack of Newbury, a worthy clothier, manifested his loyalty by equipping and placing at the disposal of the bluff monarch a goodly company of men to assist him in overcoming his enemies. Against this picture of devoted patriotism, we have to place Shakspeare's description of the social condition of the clothiers, suffering under the burden of excessive taxation. In his play of "Henry VIII." he makes the Duke of Norfolk say to the king:—

> The clothiers all, not able to maintain
> The many to them 'longing, have put off
> The spinsters, carders, fullers, weavers, who,
> Unfit for other life, compell'd by hunger
> And lack of other means, in desperate manner
> Daring the event to the teeth, are all in uproar,
> And danger serves among them.

Taxation still affects the manufacturers of woollen goods, but they are happily not reduced to such a state of despair as to be obliged to discharge their workpeople, and throw them on the stream of chance. At one time the law enacted that people should bury their dead in woollen, a circumstance on which Pope comments when he says:—

> "Odious! In woollen! 'Twould a saint provoke!"
> (Were the last words that poor Narcissa spoke).
> "No! Let a charming chintz and Brussels lace
> Wrap my cold limbs, and shade my lifeless face.
> One would not, sure, be frightful when one's dead;
> And—Betty—give this cheek a little red."

It is needless to say that this method of encouraging the manufacture of woollen goods has passed away. As a class, the clothiers have always been proud of their profession. At Newbury, in Berkshire, a certain Mr. Coxetter once laid a wager that he would produce in one day a coat from the back of a living sheep. An old print may still be seen of the sheep-shearing scene, and the subsequent production of the coat. Mr. Coxetter won his wager, and great was the rejoicing of the Newbury folk at his success. Since the

accomplishment of this feat, the industry has undergone many changes. The introduction of steam-power and the invention of improved looms have effected a marvellous development.

The cloth-mills of the West of England have kept pace with the onward march of civilisation, and in none has this been more strikingly illustrated than in those scattered at intervals throughout the beautiful Stroud valley. Among them may be especially mentioned the handsome block of buildings known as Lodgemore Mills, and the less imposing but scarcely less noted Frome Hall Mills. As is well known, West of England cloth proper is that highly-finished fabric called broadcloth, which, until quite recently, was in universal wear. The Stroud Valley may be called its home, and no district has ever been able to rival it in point of excellence. Broadcloth is, however, for the moment under a cloud, and Messrs. Strachan & Co. have promptly recognised the fact, and turned their attention to these fine woollen and worsted twilled goods which have so largely taken its place.

It must not, however, be supposed that the textile productions of these Mills end here. In addition to

LODGEMORE MILLS.

the more sombre hues of the garments of every-day life and evening wear, fine scarlet and blue cloths used by the officers of the army and navy are to be found in every stage of manufacture. Many a country gentleman who cheerily follows the chase is indebted to the employés at these Mills for his bright scarlet coat and snow-white buckskins. Here, too, are manufactured the light fabrics which, in due course, adorn the persons and preserve the health of lawn-tennis players and cricketers; whilst cloths for covering billiard-tables form a specialty, and, in considering the great perfection to which the professional and leading amateur billiard-players have brought the game, it is no exaggeration to say that the even surface of the table-cloths has greatly conduced to this end.

In the year 1871, the building which originally occupied the Lodgemore site was totally destroyed by fire; but the new Mill, with its lofty chimney stack 145 feet high, which soon succeeded it, is in every respect superior to the old one, and its close proximity to Stroud entitles it to be included among the modern structural improvements of that town. Both Mills are situated on the River Frome, from which Frome Hall takes its name. From time immemorial the water of the locality has been considered specially suited for scarlet dyeing, and the fact remains undisputed that the rich colours of the productions at the Mills now under consideration are unrivalled in this or any other part of the country.

In making an inspection of the Mills,—which together find employment for over 600 men and women, and produce goods that are sent to every part of the habitable globe,—the first department the visitor enters is that devoted to wool-sorting. The wool used is chiefly of German or Australian production, English wool being too coarse for cloths manufactured here. Breeders of Cotswolds and other English sheep are mainly anxious to produce good mutton, but in our far-off colonies and in Germany the quality, not quantity, of the wool is the great desideratum. After being sorted the wool is dyed, and then mixed with the finest olive oil preparatory to carding.

On the second floor of the Mill is a room of immense size, its internal cubicular contents being 554,374 ft., and here are employed a small army of men and women. This department may be appropriately described as one of the "busy haunts of men." To the uninitiated, the perpetual din occasioned by the rumbling of the machinery is most bewildering; but the people superintending the looms and spindles seem in no way affected by the noise. A bird's-eye glance at these rapidly-revolving machines may be sufficient to

FROME HALL MILLS.

give a faint impression of how spinning and weaving operations are carried on, but, on leaving the Mill, one cannot but feel that the knowledge obtained is, after all, of the most elementary description. The looms, with their shuttles flying merrily backwards and forwards, keeping up an endless clatter, the spinning-frames opening and closing in front of the revolving spindles, the deftness with which all the operations are carried on, will be sure to leave their impression on the mind of the casual spectator. At Lodgemore the newest American and English patent looms have been recently added to the large number previously in use. They are particularly suited for the worsted coatings now so much in vogue.

The cloth, once woven, is taken to the washing-house. Then follows the soap-felting or fulling, which sometimes occupies several days. The soap is afterwards extracted, and the cloth raised or dressed with teazles. These are specially cultivated for the purpose, and, being armed with small hooks, effectually perform the dressing function. When the cloth is dry, a cutting-machine removes the surplus pile raised by the teazles.

The condition of the manufactured article is now apparently perfect, but there yet remain some final stages before an actual state of perfection can be reached.

Lodgemore Mill is used for cloths dyed in wool, and its companion for cloths dyed in the piece. At

the former, dark-coloured fabrics are principally manufactured, while at Frome Hall Mill the productions are of lighter and brighter hues.

Messrs. Strachan & Co. leave no stone unturned to maintain the high prestige of their well-known manufactures, and have obtained the highest awards and medals at all the Exhibitions at which they have been represented. They are by no means content to rest on the laurels of the past, but, believing in the old adage that "nothing succeeds like success," they are constantly on the look-out for improved machinery and new methods of manufacturing sterling West of England cloth. The names of the two engines which keep their machinery in motion—"Capital" and "Labour"—are symbolic of the feeling existing between employers and employed; and just as Lodgemore and Frome Hall Mills are unrivalled in the Stroud Valley for structural and mechanical completeness, so the Firm may be said to enjoy the unlimited confidence of their employés, and capital and labour could not be more amicably united than in the carrying on of a great and worthy commercial enterprise.

Messrs. W. Thompson & Sons, Leicester.

AMONG the Wool and Worsted Industries of Great Britain, the ancient town of Leicester stands prominently forward as one of the principal centres. Built by King Leir about 800 B.C., it afterwards became one of the strongest Roman fortresses in Britain, and it has been the seat of the worsted, spinning, and hosiery trades for several centuries, and is one of the most enterprising and vigorous towns in the Midlands; for happily, like Birmingham, the local industries are so varied that no chronic depression is sustained by any change of fashion or want of demand of any special fabric. Foremost among its enterprising citizens, and owning one of the largest establishments, we note the firm of W. Thompson & Sons, of the St. Leonards Works, manufacturers of fingering, Berlin carpet, worsted, lambs' wool, and hosiery yarns. These mills take their name from the historical old church recently rebuilt, which was connected with the far-famed Leicester Abbey, the burial-place of the great Cardinal Wolsey.

With the characteristic courtesy of this Firm, we were conducted over their extensive works by their genial head. The mills, three in number, occupy ground covering five acres on the banks of the river Soar, and the Firm employ over 700 hands. The concern was founded some thirty-five years ago, about the time when a great impetus was given to the export trade of the country by the inauguration of the Free Trade policy and the novel and unrivalled Exhibition of 1851. The founder, Mr. W. Thompson, whose death has only recently taken place, brought a long and varied experience (dating back some fifty years) to bear upon the undertaking, and at a time when water and not steam-power was generally adopted.

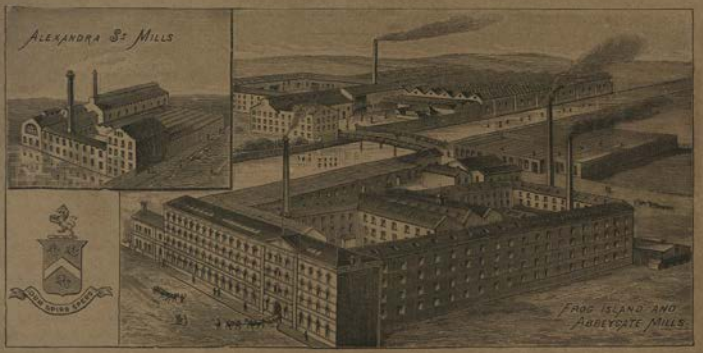
This concern from small beginnings has continued its successful career until it has grown into a large and representative one, and is ably and vigorously managed by Messrs. W. T. and J. H. Thompson, the two sons of the late founder, who had been associated with their father for many years. They claim, and with good reason, that their concern has been mainly instrumental in retaining and extending in this busy town of the Midlands, the worsted and yarn spinning industry. In spite of the "manifest destiny" that has transferred so large a bulk of the woollen and worsted trade from the West to the North of England, they may be said to form a half-way house, both commercially and geographically, for Leicester, like the Midland "Hardware Village," is so essentially the "Hub" of the kingdom, that all interested in this industry should not fail to pay a visit to this establishment as they pass through the town to the four quarters of the Kingdom, for there are specialties of manufacture connected with the Machine and Hand-Knitting industry of which they are the sole exponents in England, notably that of Berlin wool, hitherto confined to the spinners of France and Germany.

Their untiring efforts to stimulate trade, coupled with the close attention to details by the partners and their efficient staff, and the vigilant supervision to which the costly plant is subjected, embracing machinery of the very best and most modern construction, have justly placed them in the van of this industry, and the

products of the Firm are deservedly known and appreciated in all the markets of the world, as they are large exporters to the foreign and colonial markets.

The term "wool" is now almost exclusively applied to the fleece of the sheep; formerly, it embraced certain kinds of hair as well. Wool, compared with hair, is generally softer and more flexible, making it more suitable for felting purposes. Many wild animals, like the beaver and wild cat, produce both hair and wool, and the goats of Angora and of Thibet yield woolly fibres of beautiful texture, of which the fine specimens of the Cashmere shawls are made. In the time of Edward I. a duty on the exportation of wool was imposed, and in 1337 the exportation was completely prohibited. Subsequently, this law was relaxed, though subjected to heavy duties; but it was again enacted in the year 1660, and continued in force as late as the year 1824: in that year the duty on the exportation and importation of wool was one penny per pound, but by the year 1844 both duties had disappeared from the statute-book.

The term "worsted" took its name from the small town of Worstead in Norfolk, which was the birth-place of this industry, and was introduced from Flanders, like so many other of our industries, the peasants being driven from their homes by the persecutions and plunderings to which they were subjected by the constant



wars among the neighbouring princes, which made Flanders and the Low Countries the battle-field of Europe.

Wools are divided into two great classes,—clothing and combing wools, or short and long wools,—and the fabrics woven from them take the name of woollen or worsted, according to the class employed. Clothing wools possess that peculiar property which enables them to be felted or thickened, and makes the material dense and water-resisting. Combing wools, being long in fibre, are suitable for materials that do not require felting, such as Hosiery and all kinds of ladies' dress materials, Brussel carpets, curtains, and damasks.

The finest wool was formerly grown in Spain, and to this day no variety is more suitable for the carpet manufacture than a bright lustre Oporto, this being superior in texture and lustre to a home-grown wool. In 1765 the Elector of Saxony laid the foundation of that splendid variety of Wool, the Merino, by introducing a small flock into Saxony, and such attention was paid to the breeding and rearing of their progeny, that to this day they stand unrivalled for the softness and fineness of their wool.

The introduction of sheep into South America, Australia, and New Zealand has had even a greater influence on the trade. Compared with those two latter Colonies the importation of wool from other sources sinks into insignificance; in 1829 only 1,800,000 lb. were imported from them. This has grown in 1886 to the astounding amount of 430,000,000 lb., of the value of twenty millions sterling yearly. The Cape also sends a large consignment of wool, amounting to 62,000,000 lb., of the value of three millions sterling yearly.

Bailey's Hotels.

THE magnificent Hotels, illustrated on these pages, the property of Mr. James Bailey, are, in many respects, second to none in the metropolis. Their healthy situation, fashionable surroundings, and high reputation, constitute a combination of attractions which draws visitors from all parts of the Kingdom. It has been the ambition of its proprietor to provide for his numerous patrons the comforts of a luxurious home with the freedom of hotel life, and, although this palatial structure may from a cursory view give one a contrary impression, the charming suites of rooms, and the studious attention on the part of the management in matters of detail affecting the comfort of the guests, soon remove any erroneous impressions to which the magnitude of the premises might give rise.

In connexion with great additions made to Bailey's Hotel some time ago, a ball was given at which His Royal Highness the Prince of Wales, the Duke and Duchess of Edinburgh, the Princess Louise, the Crown Prince of Denmark, the Grand Duke of Hesse, and 700 of the nobility attended.

The great dining-room at "Bailey's" is magnificently decorated, and has the special feature of overlooking and opening into an ornamental garden with a cool fountain playing in the centre—an attraction no other hotel in London can boast. There are also at these Hotels beautifully-furnished ladies' drawing-rooms, well-ventilated billiard and smoking rooms, numerous bath-rooms on each floor, and suites of apartments specially reserved for wedding breakfasts and dinner parties, hydraulic lifts to each floor, strong rooms for valuables, and comfortable dining-rooms for children on the ground floors. The furniture throughout the Hotels—of the richest kind and in high taste—was supplied by Messrs. W. A. & S. Smee, of Finsbury Pavement. The kitchens are fitted up with all modern improvements. Perfect ventilation and lighting, so necessary for the maintenance of health, are carefully studied by the proprietor, who is always ready to adopt any new contrivance for the further application of the laws of hygiene, while the sanitary arrangements are most complete.

In the South Kensington Hotel the rooms are lofty and light, and the furniture is of the same costly description as that of Mr. Bailey's other splendid house. The decorations are somewhat lighter, but there is the same air of comfort and scrupulous cleanliness about both the Hotels managed by this indefatigable *entrepreneur*. The lofty hall and, indeed, all the passages are inlaid with mosaic in the Classic style, and there are several stained glass windows which soften the light without destroying much of its power of illumination. This Hotel is warmed throughout by a new apparatus, the pipes of which are hidden from view; and hot water raised to a sufficiently high temperature by means of steam, which answers two purposes (*i.e.* the heating of the rooms and the water), is supplied to every bedroom in the Hotel. By this arrangement, which was introduced for the first time, we believe, by Mr. Slater, of High Holborn, at the suggestion of Mr. Bailey, a continuous circulation of steam is effected. The culinary arrangements are particularly interesting. Roasting and grilling are done in cleverly-contrived gas

BAILEY'S HOTEL, GLOUCESTER ROAD, S.W.

ovens, which permit the products of combustion to escape. There is no smell from these cooking machines, so that visitors are never troubled with odours from the kitchens permeating the air of the other apartments.

THE SOUTH KENSINGTON HOTEL, QUEEN'S GATE TERRACE, S.W.

The whole of this department was fitted up by Mr. Slater, and is under the superintendence of an engineer, whose sole duty is to attend to the boilers and the heating apparatus.

We have noticed these improvements in the culinary contrivances because the kitchens of an Hotel being out of sight, and the circulation of reports of anything but an appetising nature respecting some of the places where food is prepared for the table, have led to the belief that in many elegant Hotels more attention might be paid to the department of the *chef de cuisine*. On the occasion of our visit to the South Kensington Hotel, we were invited by Mr. Bailey to inspect the kitchens, and we must confess that the appliances, the order observed, and the scrupulous cleanliness of the larders, and, in fact of every spot where the cooks perform their important duties, surprised us, and made us feel that the terms of reproach hurled at us by French epicures were not always merited. Gastronomy is a fine-art, practised to the highest degree of perfection on the Continent, but little understood by a large section of the inhabitants of the British Isles. During the last quarter of a century we have certainly made some progress in the art, but it is still a lamentable fact, in spite of our schools of cookery, that the French *chef* still reigns supreme in this country. There are scores of public places in England where good food is spoiled, and where the germs of dyspepsia are sown. All the more credit is, therefore, due to the proprietor of the South Kensington and Bailey's Hotels for his culinary reform and his anxiety to make the kitchen as interesting an exhibition as the most artistic room in his splendid houses. The Hotels (within five minutes' walk of each other) are most conveniently situated, being close to the Royal Albert Hall, the South Kensington Natural History Museum, Hyde Park, Royal Horticultural and Kensington Gardens. Every description of carriages are supplied from stables attached to the Hotels, while the close proximity of the Underground Railway, Gloucester Road and South Kensington Stations, renders these Hotels easy of access from all parts of the metropolis. Altogether, they are charming residences in a quiet but accessible quarter, and well deserve the extensive patronage they have hitherto received. Both Hotels were built by Messrs. Aldin & Plater, the well-known builders of Kensington, and all the decorations have been carried out under their direction.

Woods' Hotel, within Furnival's Inn, London, E.C.

IN the very heart of London, in the midst of the hurly-burly, there is one quiet spot where the din of the busy thoroughfares does not penetrate. Woods' Hotel, in Furnival's Inn—within a few minutes' ride of the principal theatres and popular places of entertainment, a shilling cab-fare to and from the same, a short walk from the British Museum, and in the centre of legal London—is a country house in town, a secluded spot, surrounded by scenes of business and pleasure, about the only hotel in the metropolis where one can find peace and quietness within a stone's throw of all the elements which unite to constitute the noisiest and busiest capital of Europe. But it is not only on account of its immunity from disturbance that Woods' Hotel is celebrated. It has historical associations which will, so long as its walls remain standing, be a source of attraction to all who revere the name of England's greatest novelist. Within that peaceful retreat the late Charles Dickens wrote part of the immortal "Pickwick Papers." The very rooms occupied by *the* master of fiction are reverentially preserved by the present proprietor of Woods' Hotel, who delights in showing them to his guests. With such strong recommendations as those above mentioned, it is no matter for surprise that this hostelry is visited by professional men from all parts of the kingdom, whose business while in town demands a residence within easy access of the City and the legal haunts of the metropolis.

Woods' Hotel, which can boast of an uninterrupted proprietorship of sixty-seven years, is the favourite house of a great number of lawyers and engineers, as well as Judges and dignitaries of the Church. Many ladies say that it is the only house in town where they can stay unaccompanied by a gentleman, because there is a special coffee-room for the fair sex; and others, who are used to attending daily prayers at home, never fail to stay at "Woods'" while in London, because there is a chapel attached to the hotel, and a chaplain who attends for prayers morning and evening, a feature introduced by the late Mr. Woods, and still strictly observed by the present proprietor, Mr. John Whaley, who, although anxious to maintain the original character of the house, is yet mindful of the wants of the present generation; therefore, without effecting a complete transformation, he has considerably modified and improved the original hotel, introducing electric bells, the most approved forms of ventilators, heating, lighting, and sanitary arrangements by John Bolding & Co., modern furniture and upholstery by Messrs. Maple & Co., without destroying that peaceful air of home comfort which has always been its chief feature.

The new wing was designed by Messrs. Isaacs & Florence, architects, and erected by Messrs. Patman & Fotheringham, the well-known builders. There are now 170 rooms in the Hotel, including a fine new smoking-room, with artistic Jacobean overmantels; this room is illuminated by the Wenham light. The bedrooms are all furnished in the same style, and contain every convenience. There are two fine coffee-rooms, and a large number of private suites of apartments. The lavatory is perfect in sanitary completeness. Mr. Whaley's wine

storage arrangements are so complete that he can boast of being able to offer a visitor a perfectly cool glass of champagne or hock in the height of summer, and a warm glass of claret in the depth of winter. Cigars, too, of the finest brands are obtainable at Woods' Hotel. There is a telephone exchange for the use of guests, and a letter-box, which is cleared every hour.

The tariff is moderate, and the *cuisine*, which is of the good old English style, is all that can be desired, the saddle of mutton being the *chef-d'œuvre* at this house. It may be useful for our readers to know that the telegraph address for Woods' Hotel is "Woodsdon, London," and that the telephone number is 2,536. The

following is extracted from the *World*, March 17, 1886:—"Some time ago, I suggested that the Society of Arts should place a mural tablet on the chambers in Furnival's Inn which were occupied by Charles Dickens while he was engaged in writing 'Pickwick.' Through the secretary of the Society (Mr. H. T. Wood), I received an obliging intimation that they would be glad to do as I proposed, but that, as it was believed that those chambers had since been absorbed into Woods' Hotel, there was some difficulty in finding the exact locality. The proprietor of the Hotel, however, has entered into the question *con amore*, and by an inspection of the rent-roll book from 1834 to 1837, he has discovered that, during the greater part of that time, Charles Dickens occupied chambers at No. 15 on the third floor, and, subsequently, at No. 12. The tablet has now, consequently, been fixed upon the wall of what were once Dickens' chambers."

Brown's Hotel, London.

MODERN London having grown to such enormous dimensions, it is clearly a matter of some importance to those who visit the Metropolis to select their hotel in the district most conveniently situated for following their respective pursuits. For a certain class of visitors, that is to say, for such as claim to be ranked among the Upper Ten Thousand, the neighbourhood of Piccadilly has, perhaps, more advantages than any other district of London. Close at hand are Hyde Park, Green Park, and St. James's Park; equally close are St. James's Palace and Buckingham Palace; and within a mile or so are the Houses of Parliament, the Government Offices, Westminster Abbey, and many of the most fashionable streets and squares in the whole of the West End. For ladies who care to spend any of their time in shopping during their visit, the magnificent shops of Regent Street, Bond Street, and Oxford Street are all quite near; while another by no means unimportant consideration is the proximity of two of the London termini, as well as of several stations on the Underground Railway.

Among the many streets leading out of Piccadilly on the north, are Dover Street and Albemarle Street, which run parallel and next to each other. Between these, and with an entrance in both, is located the ancient and celebrated hotel whose name appears at the head of this article; and very nearly opposite the entrance in Albemarle Street, stands also the Pulteney Hotel, belonging to the same proprietors. As the two establishments, however, are under the same management, and are conducted on precisely the same system, a description of one will be sufficient. The immediate locality in which Brown's Hotel is situated, although surrounded by so much bustle and life, is itself remarkably quiet; and no better spot could be found for visitors who like to have a quiet, home-like retreat while enjoying the London season. Nearly a hundred years have now passed since the hotel was opened; and during this lengthy period it has always held a leading position among London hotels, although in an unostentatious way. For the first sixty or seventy years of its existence, the establishment was the property of the Brown family; but for the last thirty years it has been in the hands of the present proprietors, Messrs. J. J. Ford & Sons, who not only have introduced many important structural alterations, but also have vastly improved on the old system of management. There is hardly a large town in all Europe or the United States, which one or other of the proprietors has not made it his special business to visit, for the purpose of studying the tastes of the people and the arrangements in the hotels there, and, with the object, if possible, of introducing further improvements into the establishment in Dover Street; and from Shepherd's Hotel at Cairo to the Palace Hotel at San Francisco, there is not one hotel of importance at which a stay has not been made with this end in view. As the result of these tours of inspection, the proprietors are in a position to meet the requirements of numerous different nationalities, and can cater as successfully for a Russian as for a Californian. As a further result their establishment, while still retaining the charm of antiquity, is fitted with every modern appliance for the convenience, comfort, and safety of their guests, and is now,

practically speaking, an old hotel modernised. The system of management has been brought as near to perfection as it well can be; and, alone among London hotel proprietors, Messrs. Ford, adopting the American custom, have abolished those petty charges for lighting and attendance which seem to be made expressly for the annoyance of guests.

The special feature about Brown's Hotel is the care bestowed on every detail. It is the nicety of the appointments, the completeness of the arrangements, the choiceness of the *menu*, that attract such a succession of notabilities to the doors of this famous hotel. The attendance, as indeed goes without saying, is excellent; and equally so is the management of the *cuisine*, which is in the hands of a head cook who for forty years has been in the employ of the proprietor's family. Under him serve no less than four carefully selected cooks,—a large number considering the size of the establishment. Nor is less commendation due to the wine list than to the bill of fare. Mr. Ford, sen., is personally acquainted with the principal Continental growers, and himself visits the wine districts of France every year for the purpose of replenishing his cellars. Yet with all this care to have everything of the very best, the tariff at Brown's Hotel is the same as at other first-class establishments in the Metropolis. In the general dining-room, which has not long been opened, the guests are able, if so disposed, to dine in company, though of course at liberty to dine in private if they prefer it. The *table d'hôte* is reserved exclusively for those who are staying at the hotel and their intimate friends, and is not open to chance comers.

Although there are a few single bedrooms in the house, the majority of the rooms are arranged in suite, with servant's room and bath-room attached, and each one with a private lavatory of its own. The various suites are decorated in different styles, in order that all guests may be suited; and the best taste is displayed in the decoration of the apartments. A very important point about every hotel is the drainage; and the greatest care has been taken by the proprietors of Brown's to see that in this respect perfection shall be as nearly attained as possible. The drainage system is periodically inspected by the medical officer of health for St. James's, in whose opinion the baths and sinks are admirably constructed, and, what is of great importance, perfectly cut off from communication with the drain. Another precaution taken to insure the safety of the inmates consists in the introduction of hydrants, which have been carried to all parts of the building, in case of fire. The servants of the establishment, moreover, are properly drilled, so that each may know exactly what to do in such an emergency. Ventilation is yet another matter of importance which has been carefully attended to. It need hardly be said that lifts are employed throughout. Nor is it surprising that the proprietors have adopted the electric light, having regard to the comfort and safety which are secured by its adoption. Every room throughout the establishment, even bedrooms and dressing-rooms are lighted by electricity; and Brown's, we believe, is the only hotel in London of which this can be said.

Taste and refinement are the peculiar characteristics about the place which strike the visitor as he enters the elegantly-decorated hall and passes into the handsome dining-room or drawing-room, or ascends the staircase to the private suites. As may be supposed, the company is very select, since the owners are far more concerned to sustain the reputation of the hotel than to increase the number of applicants for admission. Among those by whom Brown's is especially patronised are—well we will not say the American aristocracy, for that would be insulting our republican cousins, but those Americans who have found their way into the best society of London, and are visiting the British Metropolis for the gaiety of the season. The doors of the hotel are not so unaccustomed to admit persons of distinction that the entrance of every celebrity need be advertised to the world; but at the same time it may be interesting to our readers if we name a few of the many "men of light and leading" who have made this their home for a longer or shorter period. In former days, Lord Byron was in the habit of always staying here when in town; and more recently the old Royalist family of France, the Bourbons, have made this their headquarters in London. Even branches of the Bourbon family hostile to one another have sometimes resided here; Alfonso, for instance, the late King of Spain, and Don Carlos have both been among the guests. On one occasion the deposed Khedive found himself occupying a suite of rooms adjoining that in which Lord Vivian was staying; to the latter, as Minister-Plenipotentiary to Egypt, had previously fallen the very unpleasant task of announcing to the Khedive the determination of the great Powers to insist on his resignation. During the past winter the ex-Khedive was occupying the whole of the Pulteney Hotel, which by the way has lately undergone thorough renovation. But to go further into a list of the celebrities who frequent the establishment would be altogether superfluous. The Hotel, we may remark in concluding, has a separate entrance for Royalty, leading into a portion of the building which can be entirely shut off from the rest.

The Langham Hotel, London.

THIS noble pile, one of the first if not *the first* of the great metropolitan Hotels, is probably better known all over Europe and the United States than any other similar establishment in the Kingdom. The Langham may be styled a Cosmopolitan Hotel, since the management endeavour to study the requirements and the special tastes of visitors of various nationalities: striving to introduce the best points of the three systems—English, French, and American—the object being to combine the comfort of the first with the elegance of the second and the discipline and organisation of the third. In order to thoroughly appreciate the resources of this Hotel, nothing short of a three hours' tour of inspection will suffice, for within the block of buildings known as the Langham Hotel are the elements of a small town. Indeed, it would be no exaggeration to state that England possesses many thriving towns in which such luxuries and conveniences as are obtainable at the Langham are nowhere to be found. Through the kindness of Captain Gordon, whose admirable discipline is noticeable the moment the visitor enters the Hotel, we had an opportunity of judging for ourselves whether the published reports of this house were, in these days of progress, in accordance with the notions of an experienced traveller, whose vocation has led him to some of the highly-lauded establishments in the principal cities of Europe.

Like Sir Charles Coldstream in "Used Up," one can be satiated even with grand Hotels, but we must confess that we were never before so favourably impressed with Hotel management as on the occasion of our visit to the Langham. Instead of describing in detail the well-furnished suites and bedrooms, we will give the reader an idea of the internal working of this vast establishment. The kitchen first claims our notice, where a small army of cooks, under the direction of a celebrated *chef*, prepare the dishes to suit the tastes of European and American epicures. Here perfect order is observed. Two clerks are constantly on duty to check everything that leaves the kitchen. The joints are placed upon trucks, which run over tram-lines to the lifts which convey them to the coffee-room. Then there are the wine-cellars, which cover a large area, the bins being filled with every description of rare wines. Over each bin is the date of vintage, the figures 1857 being conspicuous in one place, and representing the oldest champagne vintage in the world. The manager of this department can deliver a bottle of any description of wine to the coffee-room within three minutes. He has a double lift under his charge, with a break which can be applied to steady the ascent, and thus prevent shaking the contents of the bottle. In the basement is the laundry, fitted up with all the modern improvements in washing, wringing, ironing, and mangling machines. All clothes and bed-linen are thoroughly dried in iron chambers heated by steam. A visitor can send his linen to the laundry in the morning, and have it ready for wear by the evening of the same day. "Sanitas," the best disinfectant in the market, is plentifully used in the basement, as well as in other parts of the Hotel, where the laws of hygiene are strictly observed. The plate-cleaning department, too, is worthy of notice. The Langham Hotel Company possesses between 20,000 and 30,000 pieces of plate,

10,000 pieces of which pass through the cleaners' hands daily. A service of trams runs from the kitchens to the knife-cleaning department, where two of Kent's machines are constantly at work. A grocery-store is also provided, where, in the season, from 12 cwt. to 15 cwt. of loaf sugar is cut every day. The Langham is quite independent of the Water Companies. There is an artesian well on the premises, 400 ft. deep, from which water is pumped by two engines of fourteen horse-power each. Independently of this source, the Hotel is connected with the West Middlesex Waterworks' main reservoir at Hampstead, which affords an increased supply and additional security in case of fire.

On the ground floor are numerous objects of interest and useful appliances. In the Entrance Hall we noticed an electrical cab-call. A visitor wishing to hire a vehicle has only to press a button, once for a four-wheeler and twice for a hansom: a bell rings at the nearest cab-rank, and immediately the required vehicle appears at the door of the Hotel in obedience to the summons. Here are also a handsome piece of cabinet work, supporting a clock indicating Greenwich meantime; an aneroid barometer; a thermometer; and an

THE LANGHAM HOTEL, PORTLAND PLACE, W.

instrument for showing the direction of the wind, working by means of electricity and attached to the vane on the highest tower. There is likewise in the vestibule a pillar letter-box, which is cleared about every hour, and a door leading to a branch post and telegraph office, where five clerks are employed. The telegraphic communication comprises two wires to the Central Telegraph Station. These lines are duplexed, so that two messages can be transmitted in opposite directions at the same time. We have always heard that the business of this telegraph-office has been admirably conducted by the postal and telegraph officials who are engaged at the Langham. At the telephone-office, which is also situated in the entrance hall, all the principal houses of business in London may be communicated with by the aid of the Telephone Company's Exchange in Cannon Street. Any firm on the list, which numbers some thousands, can be switched on to the Langham telephone at the request of the visitor. Among other important features at this hotel are the box-office for the sale of tickets for the opera, theatre, &c.; the book and newspaper stall; Messrs. Cook's office, where one

can take tickets for travelling to all parts of the world. This department is a great convenience to Americans who have not booked for the return passage. In the eastern, or left-hand wing, are situated a noble suite of apartments, consisting of the ladies' drawing-room, general sitting-room, and ladies' music-room, *en suite*, and overlooking Langham Place and the quaint architectural church known as All Souls', with its peculiar steeple. In the latter room is one of Erard's grand pianofortes. The *salle à manger*, or general dining-hall,—or, as it is more commonly known in England, the coffee-room,—is a noble apartment 120 feet in length by 47 feet in breadth, richly decorated with columns of composite to imitate white Carrara marble, extending the whole length on each side, with lofty windows lighting it from the south, and corresponding ones overlooking the spacious courtyard to the north. In the summer season a string band "discourses most eloquent music" during the dinner-hour in a *marquée* erected in the courtyard amidst rich displays of fine shrubs and beautiful flowers.

The billiard-rooms are fitted with three of Burroughs & Watts's improved tables, with combination cushions. The corridors are remarkably light, cheerful, and well ventilated, paved with encaustic tiles in rich mosaic, and appropriately ornamented with statuary,—England's noble poet, Shakspeare, occupying a central position. The lavatories are fitted up in Jennings's best style, and are perfect in sanitary construction, while the ladies' and gentlemen's hair-dressing saloons are great conveniences to the visitors. The different floors are reached by two fine staircases, but the modern Sybarite or the invalid can always travel by the hydraulic lifts (there being two for passengers), which are elegantly-decorated travelling-rooms, and deliver passengers on each landing. When a visitor wishes to descend by the lift he has only to press an electric bell-push, and instantly the room rises, with an attendant to receive him. On the second landing is the lofty and commodious corridor of the first story, running the whole length of the four sides of the house. On this floor are situated the principal suites of apartments, elaborately fitted up and gorgeously decorated, presenting accommodation fit for a prince. On the same floor is a magnificent room, almost exclusively used for wedding breakfasts, of which a large number are given at this Hotel. There are, in all, thirty-two drawing-rooms, and thirty-four suites, comprising bed, bath, and dressing rooms, and over 350 single and double bedrooms attached.

This is a very brief and imperfect description of this wonderful Hotel, which was opened to the public in 1865, and created quite a sensation at the time, being the first of a series of magnificent Hotels, of which the Londoner is justly proud. The entire cost of the original building was £300,000 sterling, subsequent decorations cost £40,000, and the work of renovating and beautifying is still going on. We must not fail to mention that every precaution is taken to prevent accidents by fire. Four men, late of the Metropolitan Fire Brigade, are always on duty, under the superintendence of an experienced and very intelligent fireman, who showed us, with pardonable pride, the admirable arrangements under his control. Although situated in the centre of London, the walls are so thick that the noise of the outside traffic cannot be heard in any part of the Hotel. The cab-fare to the principal theatres is one shilling, and it is within walking distance of the two principal parks of the metropolis, besides being in the centre of all the most fashionable shops. We cannot quit the subject without remarking on the general alacrity exhibited by the servants in the execution of orders, and the evident smoothness with which the establishment is worked.

The Midland Grand Hotel, St. Pancras, London.

THE latest census shows, while London has increased very much in population it has, at the same time, become the equal, if not the superior, of the chief cities of the Continent and of the United States as regards the number and extent of its hotels. Foremost among them is the magnificent building which forms the terminus of the Midland Railway. Its situation is an admirable one, especially as regards salubrity, for it stands at a higher level than the dome of St. Paul's, and is, therefore, freer than any of the other first-class London hotels from the river fogs which visitors to the Metropolis find so trying. In point of comfort, too, it is unequalled, combining the best features both of the English and the Continental systems. The hotel was designed by that master of the ornate Gothic style, Sir G. Gilbert Scott, and has a frontage of 600 feet. It is one of the few architectural ornaments of London, and has been described by an eminent authority as a veritable railway palace and the most perfect establishment of its kind in the world.

The main entrance is direct from the Euston Road into the western curved wing. The guest, on his arrival beneath the large porch, finds himself in a spacious hall, with the reception and information offices to his right, while to the left is the office of the hall-porter, in which letters and parcels are placed. Further on is the passenger lift, while in a recess to the left are the baggage and cloak-rooms, together with a lift worked by hydraulic power. To the right is the general coffee-room, 100 feet long, 30 feet wide, and 24 feet high ventilated by shafts, and following the curve of this wing. Close to it are the new smoking-room, the new lavatory, a hair-dressing saloon, and a private bar.

Just opposite the principal entrance to the coffee-room is the grand staircase, which ascends as far as the third floor, and is lighted by three two-light windows. These windows reach as far as the roof, to a height of 80 feet, and are divided by four transom windows; the whole is crowned by a groined ceiling, with stone ribs and carved bosses at the intersections, filled in with Portland concrete a foot thick, the face being finished off with Parian cement, over which is a decoration of emblematic frescoes. The groined ribs spring from stone corbels, and are supported by polished columns of green Irish marble. Ascending the first floor of this staircase, and turning to the right, the visitor passes into the general drawing and reading-room, which is a lofty, large, and well-decorated apartment, with five windows looking out into the Euston Road, and with a terrace which in summer has a handsome awning and is made bright with flowers and shrubs.

Close by is the music-room, another splendidly-furnished apartment, while immediately adjoining it is the private coffee-room, for the use of which no extra charge is made, and which is intended to secure greater quiet and seclusion for ladies and others not accustomed to hotel life. This room is close to the western end of the main corridor, which runs from one extremity of the building to the other, a length of about 500 feet, and which leads to the splendid suites of sitting and bed-rooms so well known to regular visitors to the hotel. Walking down

the corridor, covered with a deep-piled Axminster carpet which hushes all sound, there are rooms on each side, those to the right having balconies overlooking the wide space of ground facing the Euston Road. The spacious and lofty apartments, and the handsome furniture, the luxurious carpets, the massive silken or woollen curtains, the linoleum blinds, the wardrobes, the chests of drawers, the clocks, the writing-tables, the sofas and the easy chairs, with which the apartments are supplied, and all of which have just been renewed, are such as to satisfy the requirements of the most fastidious. Yet the use of them is to be had at such a cost as to make it clear that the object of the Company has been, not to make the largest profit, but to give the greatest comfort to their customers; while, now that they have reduced the tariff and abolished the charge for attendance, this hotel may be described as the most sumptuous, comfortable, and economical in existence.

THE MIDLAND GRAND HOTEL, ST. PANCRAS, LONDON.

The recent metropolitan improvements, moreover, have now brought the Midland Hotel so close to the West End, that the walk, by way of St. Pancras Church, through the newly-opened Shaftesbury Avenue, to Piccadilly or Charing Cross, takes little more than twenty minutes. The hotel is within a shilling cab-fare of all the principal theatres, a list of which will be found in the grand hall, as well as of most other places of amusement and business centres. Although about 70,000 visitors stayed in the hotel last year it never seemed crowded, the staircases being so spacious and evenly distributed throughout the house. The grand staircase and the corridors are full of pleasant lounging-places, while the drawing-rooms, smoking-rooms, and lavatories are all well lighted and above ground, this being rarely the case in the large London hotels.

Special provision has been made for the service of high-class dinners and banquets in the splendid suites of rooms which are available for the purpose. Persons of taste and refinement can count upon enjoying dinners or luncheons cooked in the finest Continental style, with the purest of wines, and what is more, served with all the quiet and good order of the best-conducted private house. It may be said, in a word, that while the Midland Hotel is specially convenient for travellers spending only a day or two in London, it is not less desirable as a residence for those who want to stay some time in the Metropolis, and who are anxious to avoid the expense of a temporary town house or the discomfort of a lodging.

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